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THE PRINCIPLES OF PSYCHOLOGY

BY

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PREFACE TO VOL. II.

Of this second volume, as of the first volume, it may be said that it is more a new work than a new edition. The only one of its several divisions which retains substantially its original shape, is Part VI., Special Analysis. In this, such changes of significance as will be found, have arisen by the addition of §§ 302—305, showing that the subject-matter of Logic is objective, and by the further developments given to the chapters on "The Perception of Body as Presenting Statical Attributes," "The Perception of Space," and "The Perception of Motion,"—developments by which the doctrine set forth in those chapters, has been more fully harmonized with the Doctrine of Evolution Part VIII., General Analysis, though it contains fragments of the Part which bore that title in the First Edition, is mainly new in substance and wholly new in organization; and to Part IX., Corollaries, there was nothing answering in the First Edition. In round numbers, 350 pages of fresh matter are added to 300 pages of matter that has appeared before.

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PART VI.

SPECIAL ANALYSIS.

CHAPTER I.

LIMITATION OF THE SUBJECT.

§ 274. Unless he is warned against doing so, the reader will expect to find in the following chapters analyses of states of consciousness of all orders. The phenomena presented by the emotions, as well as those presented by the intellect, will be assumed to fall within the scope of the inquiry. A resolution into their components, not only of thoughts, but also of sentiments, will be looked for.

On comparing these two orders of our mental states, however, it will be seen that though one of them promises to yield satisfactory results under analysis, the other does not. Anything that is to be explained by separation of its parts and examination of the modes in which they are joined to one another, must be something which presents distinguishable parts united in definable ways. And when we have before us something which, though obviously composite, has its heterogeneous elements so mingled and fused together that they cannot be severally identified with clearness, we may conclude that an attempted analysis, if not absolutely fruitless, will bring us to conclusions that are doubtful or incomplete, or both. Now these contrasted characters are possessed by the modes of consciousness we class respectively as intellectual and emotional. A thought, no matter how simple or how complex, contains more or less definable and nameable elements, having connexions

that may be described with distinctness. But a sentiment is altogether vague in its outlines, and has a structure which continues indistinct even under the most patient introspection. Dim traces of different components may be discerned; but the limitations both of the whole and of its parts are so faintly marked, and at the same time so entangled, that none but very general results can be reached. And this is a character which the genesis of the emotions, as we have traced it, necessarily implies. Whoever recalls §§ 214, 247 in Parts IV. and V., will see that emotions, having been evolved by the consolidation of clusters upon clusters of heterogeneous simple feelings, and the consolidation of such compound clusters into still larger and more heterogeneous ones, will see that analysis must fail to resolve them into their components.

Passing over the emotions, therefore, as not admitting of further interpretations than those which we reached synthetically in the last volume, we will here limit our analyses to the phenomena classed as intellectual.

§ 275. An analysis conducted in a systematic manner, must begin with the most complex phenomena of the series to be analyzed. After resolving them into phenomena that stand next in order of complexity, it must proceed similarly with these components; and so, by successive decompositions, must descend to the simpler and more general, reaching at last the simplest and most general. Consistently to pursue this method throughout Subjective Psychology is difficult. The commonest operations of consciousness are perplexing to persons unaccustomed to introspection, and its highly-involved operations, if dealt with at the outset, may be expected to tax the powers even of the habitual student.

Disadvantageous, however, in this respect, as such an arrangement of the subject may be, it is so much the best fitted for exhibiting the general law which it is the object of this Special Analysis to disclose, that I do not hesitate

to adopt it. A little patience only is asked during the perusal of the next few chapters. What he finds in them that is not very comprehensible, the reader must pass over until subsequent chapters give the key to it. Should some of the matters discussed seem to him unimportant, perhaps he will suspend his judgment until their bearing on the doctrine at large becomes visible. And if he should not perceive the reason for interpreting certain mental phenomena after a particular manner, he is requested to take the analyses upon trust, in the belief that they will eventually be justified.

CHAPTER II.

COMPOUND QUANTITATIVE REASONING.

§ 276. Of intellectual acts the highest are those which constitute Conscious Reasoning—reasoning called conscious to distinguish it from the unconscious or automatic reasoning that forms so large an element in ordinary perception. Of conscious reasoning the kind containing the greatest number of components definitely combined is Quantitative Reasoning. And of this, again, there is a division, more highly involved than the rest, which we may class apart as Compound Quantitative Reasoning. With it, then, we must set out.

Even in Compound Quantitative Reasoning itself there are degrees of composition, and to initiate our analysis rightly we must take first the most composite type. Let us contemplate an example of it.

§ 277. Suppose an engineer has constructed an iron tubular bridge, and finds that it is just strong enough to bear the strain it is subject to—a strain resulting mainly from its own weight. Suppose further that he is required to construct another bridge of like kind, but of double the span. Possibly it will be concluded that for this new bridge he might simply magnify the previous design in all its particulars—make the tube double the depth, double the width, and double the thickness, as well as double the

length. But he sees that a bridge so proportioned would not support itself—he infers that the depth or the thickness must be more than double.

By what acts of thought does he reach this conclusion? He knows, in the first place, that the bulks of similar masses of matter are to each other as the cubes of the linear dimensions; and that, consequently, when the masses are not only similar in form but of the same material, the weights also are as the cubes of the linear dimensions. He knows, too, that in similar masses of matter which are subject to compression or tension, or, as in this case, to the transverse strain, the power of resistance varies as the squares of the linear dimensions.* Hence he sees that if another bridge be built proportioned in all respects exactly like the first but of double the size, the weight of it—that is, the gravitative force, or force tending to make it bend and break—will have increased as the *cubes* of the dimensions; while the sustaining force or force by which breaking is resisted, will have increased only as the *squares* of the dimensions, and that the bridge must therefore give way. Or, to present the reasoning in a formal manner, he sees that the—

$$\left.\begin{matrix}\text{Sustaining force}\\ \text{in the small tube}\end{matrix}\right\} : \left\{\begin{matrix}\text{Sustaining force}\\ \text{in the large tube}\end{matrix}\right\} :: 1^2 : 2^2$$

whilst at the same time he sees that the—

$$\left.\begin{matrix}\text{Destroying force}\\ \text{in the small tube}\end{matrix}\right\} : \left\{\begin{matrix}\text{Destroying force}\\ \text{in the large tube}\end{matrix}\right\} :: 1^3 : 2^3$$

Whence he infers that as the destroying force has increased in a much greater ratio than the sustaining force, the larger

* For simplicity's sake, I here state the law in its unqualified form—a form implying that the sides of the tube retain their original attitudes when exposed to the strain. In fact, however, the tendency to twist or warp, technically called "buckling," more difficult to prevent as the tube is increased in size, will imply a diminution in the ratio of increasing strength. But that the strength will increase in a smaller ratio than the squares of the dimensions, makes the engineer's inference all the more certain.

tube cannot sustain itself; seeing that the smaller one has no excess of strength.

But now, leaving out of sight the various acts by which the premisses are reached and the final inference is drawn, let us consider the nature of the cognition that the ratio between the sustaining forces in the two tubes, must differ from the ratio between the destroying forces; for this cognition it is which here concerns us, as exemplifying the most complex ratiocination. There is, be it observed, no direct comparison between these two ratios. How then are they known to be unlike? Their unlikeness is known through the intermediation of two other ratios to which they are severally equal.

The ratio between the sustaining forces *equals* the ratio $1^2 : 2^2$. The ratio between the destroying forces *equals* the ratio $1^3 : 2^3$. And as it is seen that the ratio $1^2 : 2^2$ is unequal to the ratio $1^3 : 2^3$; it is by implication seen, that the ratio between the sustaining forces is unequal to the ratio between the destroying forces. What is the nature of this implication? or rather—What is the mental act by which this implication is perceived? It is manifestly not decomposable into steps. Though involving many elements, it is a single intuition; and if expressed in an abstract form amounts to the axiom—Ratios which are severally equal to certain other ratios that are unequal to each other, are themselves unequal.

I do not propose here to analyze this highly complex intuition. I simply present it as an example of the more intricate acts of thought which occur in Compound Quantitative Reasoning—an example to which the reader may hereafter recur if he pleases. A nearly allied but somewhat simpler intuition will better serve to initiate our analysis.

§ 278. This intuition is embodied in an axiom which has not, I think, been specifically stated; though it is taken for granted in Proposition XI. of the fifth book of Euclid;

where, as we shall presently see, the avowed reason for the inference, has this unavowed implication. This proposition, which is to the effect that "Ratios which are equal to the same ratio are equal to one another," it will be needful to quote in full.* It is as follows:—

"Let A be to B as C is to D; and as C is to D so let E be to F. Then A shall be to B as E to F.

G———————	H———————————	K———————
A———————	C———————	E———
B———	D———————	F—
L———————	M———————————	N———————

Take of A, C, E, any equimultiples whatever G, H, K; and of B, D, F, any equimultiples whatever L, M, N.† Therefore since A is to B as C to D, and G, H, are taken equimultiples of A, C, and L, M, of B, D; if G be greater than L, H is greater than M; and if equal, equal; and if less, less. Again, because C is to D as E to F, and H, K, are equimultiples of C, E; and M, N of D, F; if H be greater than M, K is greater than N, and if equal, equal; and if less, less. But if G be greater than L, it has been shown that H is greater than M; and if equal, equal; and if less, less: therefore, if G be greater than L, K is greater than N; and if equal, equal; and if less, less. And G, K are any equimultiples whatever of A, E; and L, N, any whatever of B, F; therefore as A is to B so is E to F."

* In some editions the enunciation runs,—"Ratios which are the same to the same ratio are the same to each other;" but the above is much the better.

† For the aid of those who have not lately looked into Euclid, it will be well to append the definition of proportionals, which is as follows:—"If there be four magnitudes, and if any equimultiples whatsoever be taken of the first and third, and any equimultiples whatsoever of the second and fourth, and if, according as the multiple of the *first* is greater than the multiple of the *second*, equal to it or less, the multiple of the *third* is also greater than the multiple of the *fourth*, equal to it or less; then, the *first* of the magnitudes is said to have to the *second* the *same ratio* that the *third* has to the *fourth*.

For the sake of simplicity, let us neglect such parts of this demonstration as consist in taking equimultiples and drawing the immediate inferences, and ask by what process is established that final relation among these equimultiples which serves as premiss for the desired conclusion. And to make the matter clearer, we will separate these equimultiples from the original magnitudes; and consider by itself the augument concerning them.

G———— H———— K————
L——— M———— N———

From the hypothesis and the construction, it is proved that if G be greater than L, H is greater than M; and if equal, equal; and if less, less. So, too, it is proved that if H be greater than M, K is greater than N; and if equal, equal; and if less, less. Whence it is inferred that if G be greater than L, K is greater than N; and if equal, equal; and if less, less. In general language then, the fact established is, that whatever relation subsists between G and L, the same relation subsists between H and M: whether it be a relation of superiority, of equality, or of inferiority. *So far as they are defined*, the relations G to L and H to M are known to be equal. Similarly with the relations H to M and K to N, which are known to be equal in respect to the characteristics predicated of them. And then, when it has been shown that the relation G to L equals the relation H to M; and that the relation K to N also equals it; it is said that *therefore* the relation G to L equals the relation K to N. Which *therefore*, involves the assumption that relations which are equal to the same relation, are equal to each other.

Perhaps the rejoinder will be this:—"In asserting that if G be greater than L, H is greater than M; and if equal, equal; and if less, less; it is *not* asserted that the relation G to L *equals* the relation H to M. Without negativing the assertion, G may be supposed to exceed L in a greater proportion

than H exceeds M; and, in this case, the relations will not be equal." It might, I think, be argued that the possibility of this supposition arises from the vagueness of the definition of proportional magnitudes; and that it needs only to seize the true meaning of that definition, to see that no such supposition is permissible. Not to dwell on this, however, it will suffice to point out, that though the relations G to L, and H to M, are left to some extent indeterminate, and cannot therefore be called equal in an absolute sense, yet, *so far as they are determinate*, they are equal. Consider the proposition under one of its concrete aspects. Suppose it has been shown that if G be greater than L, H is greater than M; and that if H be greater than M, K is greater than N; then it is said that if G be greater than L, K is greater than N. What are here the premisses and inference? It is argued that the first relation being like the second in a certain particular (the superiority of its first magnitude); and the third relation being also like the second in this particular; the first relation must be like the third in this particular. The same argument is applicable to any other particular; and therefore to all particulars. Whence the implication is that relations that are like the same relation in all particulars, or are equal to it, are like each other in all particulars, or are equal.

Thus the general truth that relations which are equal to the same relation are equal to each other—a truth of which the foregoing proposition concerning ratios is simply one of the more concrete forms—must be regarded as an axiom. Like its analogue—things that are equal to the same thing are equal to each other—it is incapable of proof. Seeing how closely, indeed, the two are allied, some may contend that the one is but a particular form of the other, and should be included under it. They may say that a *relation* considered quantitatively is a species of *thing;* and that what is true of all things is, by implication, true of relations. Even were this satisfactorily shown, however, it

would be needful, as will presently be seen, to enunciate this general law in respect to relations. At the same time the criticism serves to bring into yet clearer view the axiomatic nature of the law. For whether a quantified relation be or be not rightly regarded as a thing, it is unquestionably true that in the intellectual process by which relations that are equal to the same relation are perceived to be equal to each other, the concepts dealt with are the relations, and not the objects between which the relations subsist; that the equality of these relations can be perceived only by making *them* the objects of thought; and that hence the axiom, being established by the comparison of three concepts, is established by the same species of mental act as that which has for its terms substantive things instead of relations.

The truth—Relations that are equal to the same relation are equal to each other—which we thus find is known by an intuition,* and can only so be known, underlies important

* Here, and throughout, I use this word in its common acceptation, as meaning any cognition reached by an undecomposable mental act; whether the terms of that cognition be *presented* or *represented* to consciousness. Sir William Hamilton, in classing knowledge as *representative* and *presentative* or *intuitive*, restricts the meaning of intuition to that which is known by external perception. If, when a dog and a horse are looked at, it is seen that the one is less than the other, the cognition is intuitive; but if a dog and a horse are imagined, and the inferior size of the dog perceived in thought, the cognition is not intuitive in Sir William Hamilton's sense of the word. As, however, the act by which the relation of inferiority is established in consciousness, is alike in the two cases, the same term may properly be applied to it in either case. And I draw further reason for using the word in its common acceptation, from the fact that a definite line between presentative and representative *knowledge* cannot be drawn; though it can be drawn between presentative and representative *feelings*. Though there is much knowledge that is purely representative, there is none that is purely presentative. Every perception whatever involves more or less of representation. And this is asserted by Sir William Hamilton himself, when, in opposition to Royer Collard's doctrine, that perception excludes memory, he writes—"On the contrary, I hold, that as memory, or a certain continuous representation, is a condition of consciousness, it is a condition of perception."

parts of geometry. An examination of the first proposition in the sixth book of Euclid, and of the deductions made from it in succeeding propositions, will show that many theorems have this axiom for their basis.

§ 279. But on this axiom are built far wider and far more important conclusions. It is the foundation of all Mathematical analysis. Alike in working out the simplest algebraical question, and in performing those higher analytical processes of which algebra is the root, it is the one thing taken for granted at every step. The successive transformations of an equation are linked together by acts of thought, of which this axiom expresses the most general form. True, the assumption of it is limited to that particular case in which its necessity is so self-evident as to be almost unconsciously recognized; but it is not the less true that this assumption cannot be made without involving the axiom in its entire extent. Let us analyze an example—

$$\begin{aligned} x^2 + 2x &= 8 \\ x^2 + 2x + 1 &= 9 \\ x + 1 &= \pm 3 \\ x &= 2 \text{ or } -4. \end{aligned}$$

Now it may seem that the only assumptions involved in these three steps are—first, that if equals be added to equals, the sums are equal; second, that the square roots of equals are equals; and third, that if equals be taken from equals, the remainders are equal. But a further all-important assumption has been tacitly made. As at present written, there is nothing to mark any connexion between the first form of the equation and the last. Manifestly, however, the validity of the inference $x = 2$, depends on the existence of some perfectly specific connexion between it and the original premiss $x^2 + 2x = 8$; and this connexion implies connexions between the inter-

mediate steps. These connexions will be at once recognized on inserting the required symbols, thus :—

$$\begin{aligned} x^2 \quad 2x &= 8 \\ \| & \\ x^2 + 2x + 1 &= 9 \\ \| & \\ x + 1 &= 3 \\ \| & \\ x &= 2. \end{aligned}$$

Only through the successive cognitions represented by these signs of equality placed vertically, does the conclusion follow from the original premiss. The argument is worthless unless the value of x in the last form of the equation, is the same as its value in the first form; and this implies the preservation throughout, of an equality between the function of x and the function of its value. But now, in virtue of what assumption is it that the final relation between the two sides of the equation is asserted to be equal to the initial relation? On this assumption it is that the worth of the conclusion depends; and for this assumption no warrant is assigned. I answer, the warrant for this assumption is the axiom—Relations that are equal to the same relation are equal to each other. To make it clear that this axiom is involved, it needs but to simplify the consideration of the matter. Suppose we represent the successive forms of the equation by the letters A, B, C, D. If A, B, C, D had represented substantive things; and if, when it had been shown that A was equal to B, and B was equal to C, and C was equal to D, it had been concluded that A was equal to D; what would have been assumed? There would have been two assumptions of the axiom—Things that are equal to the same thing are equal to each other: one to establish the equality of A and C by the intermediation of B; and one to establish the equality of A and D by the intermediation of C. Now the fact that A, B, C, D, do not stand for things, but stand for

relations between things, cannot fundamentally alter the mental act by which the equality of the first and last is recognized. If, when A, B, C, D, are things, the equality of the first and last can be shown only by means of the axiom—Things that are equal to the same thing are equal to each other; then, when A, B, C, D, are relations, the equality of the first and last can be shown only by means of the axiom—Relations that are equal to the same relation are equal to each other.

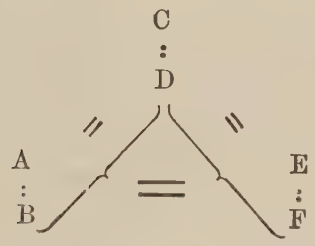
It is true that in this case the relations dealt with are relations of equality; and the great simplification hence resulting may raise a doubt whether the process of thought really is the one described. Perhaps it will be argued that the successive forms of the equation being all relations of equality, it is known by an act of direct intuition that any one of them is equal to any other; or that if an axiom be implied, it is the axiom—All relations of equality are equal to each other. Doubtless relations of equality, unlike all other relations and unlike all magnitudes, are in their very expression so defined that the equality of any one of them to any other may be foreknown. But conceding this, the objection may still be met. For how is the relation between the two sides of an equation when reduced to its final form, known to be a relation of equality? Only through its affiliation on the original relation of equality, by means of all the intermediate relations. Strike out in the foregoing case the several transformations which link the first and last forms of the equation together, and it cannot be inferred that x equals 2. If, then, this ultimate relation is known to equal the first, only because it is known to equal the penultimate relation, and the penultimate relation to equal the antepenultimate, and so on; it is clear that the affiliation of the last relation on the first, involves the axiom—Relations that are equal to the same relation are equal to each other.

It must be admitted that in cases like these, where this general axiom is applied to relations of equality, it seems a superfluity. The alleged cognition here merges into a simpler order of cognitions, from which it is with difficulty distinguishable. Nevertheless, I think the arguments adduced warrant the belief that the mental process described is gone through; though perhaps almost automatically. And for this belief further warrant will be found when, under another head, we come to consider the case of inequations—a case in which no such source of difficulty exists, and yet in which the process of thought is unquestionably of like nature.

§ 280. Leaving here its several applications, and passing to the axiom itself, we have now to inquire by what mental act it is known that relations which are equal to the same relations are equal to each other. We have seen that this truth is not demonstrable, but can be reached only by direct intuition. What is the character of this intuition?

If the equality of the first and third relations is not proved but internally perceived, the internal perception must be one in which the first and third relations are in some way brought together before consciousness. Yet any direct comparison of the first and third without intermediation of the second would avail nothing; and any intermediation of the second would seem to imply a thinking of the three in serial order—first, second, third; third, second, first—which would not bring the first and third into the immediate connexion required. Hence, as neither a direct comparison of the first and third, nor a serial comparison of the three, can fulfil the requirement, it follows that they must be compared in couples. By the premisses it is known that the first and second relations are equal, and that the second and third relations are equal. Consequently, there are presented to consciousness, two relations of equality between relations. The direct intuition is that these two

relations of equality are themselves equal. And as these two relations of equality possess a common term, the intuition that they are equal *involves* the equality of the remaining terms. The nature of this intuition will, however, be best shown by symbols. Suppose the several relations to stand thus—A : B = C : D = E : F; then the act of thought by which the equality of the first and third relations is recognized, may be symbolized thus—*



Introspection will, I think, confirm the inference that this represents the mental process gone through—that the first and second relations, contemplated as equal, form together one concept; that the third and second, similarly contemplated, form together another concept; and that, in the intuition of the equality of these concepts, the equality of the terminal relations is implied: or that, to define its nature abstractedly—the axiom expresses an intuition of the equality of two relations between relations.

To the minds of some readers this analysis will not at once commend itself. Indeed, as at first remarked, one inconvenience attendant on beginning with the most complex intellectual processes, is that the propriety of formulating them after a certain manner cannot be clearly

* The sign (:) used in mathematics to express a ratio, is, in this formula, as in many that follow, placed somewhat unusually in respect to the letters it connects, with a view to convenience of reading. It may here be added, in preparation for succeeding chapters, that this sign, though here marking, as it commonly does, a ratio, or *quantitative relation*, will hereafter be used to mark *any relation*.

seen till analysis of the simpler intellectual processes has shown why they must be thus formulated. After reading the next few chapters, the truth of the above conclusion will become manifest. Meanwhile, though it may not be positively recognized as true by its perceivable correspondence with the facts of consciousness, it may be negatively recognized as true by observing the impossibility, lately shown, of establishing the equality of the first and last relations by any other intellectual act.

Before ending the chapter it should be noted that the relations thus far dealt with are relations of magnitudes, and, properly speaking, relations of homogeneous magnitudes; or, in other words, *ratios*. In the geometrical reasoning quoted from the fifth book of Euclid, this fact is definitely expressed. In the algebraical reasoning, homogeneity of the magnitudes dealt with seems, at first, not implied; since the same equation often includes at once magnitudes of space, time, force, value. But on remembering that these magnitudes can be treated algebraically, only by reducing them to the common denomination of *number*, and considering them as abstract magnitudes of the same order, we see that the relations dealt with are really those between homogeneous magnitudes—are really *ratios*. The motive for constantly speaking of them under the general name *relations*, of which ratios are but one species, is that only when they are so classed, can the intellectual processes by which they are co-ordinated be brought under the same category with other acts of reasoning.

CHAPTER III.

COMPOUND QUANTITATIVE REASONING, CONTINUED.

§ 281. The results just reached do not, apparently, help us very far on the way to a theory of Compound Quantitative Reasoning. Such an intuition as that expressed in the axiom educed, can be but one among the many intuitions which, joined together, form a mathematical argument. However many times quoted, or applied in thought, the axiom—Relations which are equal to the same relation are equal to each other, can never do anything else than establish the equality of some two relations by the intermediation of a series of relations severally equal to both; and it is but in a moiety of cases that the equality of two relations is the fact to be arrived at. The proposition—"If two circles touch each other externally, the straight line which joins their centres shall pass through the point of contact," is one with which such an axiom can have no concern; and the same is manifestly the case with most geometrical truths. Some more general cognition, then, has to be found.

Guidance in the search for such a cognition, may be drawn from the consideration that it must be involved not only in all other kinds of quantitative reasoning, but *also* in the kind exemplified in the preceding chapter. This being an *à priori* necessity, it follows that as, in the case of algebraic reasoning, the foregoing axiom expresses the sole cognition by which the successive steps are rationally co-

ordinated, the required fundamental cognition must be involved in it. Evidently, our best course will be to continue the line of analysis already commenced.

If, then, ceasing to consider in its totality the complex axiom—Relations which are equal to the same relation are equal to each other, we inquire what are the elements of thought into which it is proximately decomposable; we at once see that it twice over involves a recognition of the equality of two relations. Before it can be seen that the relations A : B and E : F, being severally equal to the relation C : D, are equal to each other; it must be seen that the relation A : B *is* equal to the relation C : D, and that the relation C : D *is* equal to the relation E : F. And this is the intellectual act of which we are in search. An intuition of the equality of two relations is implied in every step of quantitative reasoning—both that which deals with homogeneous magnitudes and that which deals with magnitudes not homogeneous. Let us take as our first field for the exemplification of this fact, the demonstration of geometrical theorems.

§ 282. We will begin by looking at the substance of a proposition; and will consider by what process the mind advances from that particular case of it which the demonstration establishes, to the recognition of its general truth. Let us take as an example, the proposition—"The angles at the base of an isosceles triangle are equal to each other."

To prove this, the abstract terms are forthwith abandoned, and the proposition is re-stated in a concrete form. "Let A B C be an isosceles triangle, of which the side A B is equal to the side A C; then the angle A B C shall be equal to the angle A C B." By a series of steps which need not be here specified, the way is found from these premisses to this conclusion. But now mark what takes place. As soon as this particular fact has been proved, the general fact is

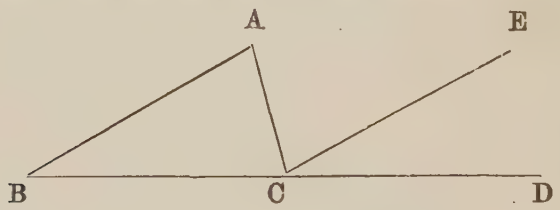
immediately re-enunciated and held to be proved. We pass directly from the concrete inference—the angle A B C *is* equal to the angle A C B—to the abstract inference: we say—*therefore* the angles at the base of an isosceles triangle are equal to each other. Q.E.D. Be the cogency of every step in the demonstration what it may, the truth of the proposition at large hinges entirely on the cognition that what holds in one case holds in all cases. What is the nature of this cognition? It is a consciousness of the equality of two relations—on the one hand, the relation between the sides and angles of the triangle A B C; and on the other hand, the relation between the sides and angles of another isosceles triangle, of any isosceles triangle, of all isosceles triangles. Whatever may be the way in which we figure to ourselves a class, this conclusion holds. Whether in the present case the abstract truth be recognized only after it has been seen to hold in this isosceles triangle, and in this, and in this; or whether after it has been seen to hold in some ideal type of an isosceles triangle; it is alike certain that the thing discerned is the equality of the relations presented in successive concepts. If we use the letter A to symbolize the premised fact (viz. that in the triangle A B C the sides A B and A C are equal), and the letter B to symbolize the fact asserted (viz. that the angle A B C is equal to the angle A C B); then, after establishing a certain relation (of coexistence) between A and B in this one case, we go on to affirm that the same relation holds between some other A and B, and between every A and every B: or, strictly speaking, not the *same* relation but an *equal* relation. And as we can assign no reason, the affirmation obviously expresses a simple intuition.

Not only do we pass from the special truth to the general truth by an intuition of the equality of two relations; but a like intuition constitutes each of the steps by which the special truth is reached. In the demonstration of such special truth, the propositions previously established are explicitly

or implicitly referred to; and the relations that subsist in the case in hand are recognized as equal to relations which those previously-established propositions express. This will be seen on subjecting a demonstration to analysis. The one belonging to the foregoing theorem is inconveniently long. We shall find a fitter one in Proposition xxxii.

"If the side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles; and the three interior angles of every triangle are together equal to two right angles.

"Let A B C be a triangle, and let one of its sides B C be produced to D; then the exterior angle A C D is equal to the two interior and opposite angles C A B, A B C; and the three interior angles of the triangle, namely A B C, B C A, C A B, are together equal to two right angles.



DEMONSTRATION.

"From the point C draw the straight line C E parallel to A B; and because A B is parallel to C E, and A C meets them, the alternate angles B A C, A C E are equal.

"Again, because A B is parallel to C E, and

ANALYSIS.

It was demonstrated in a previous case, that there is a relation of co-existence between the parallelism of two lines and the equality of the alternate angles made by a line meeting them. It is perceived that the parallelism of the lines must coexist with the equality of the angles in this case also. That is, the present relation is seen to be equal to a relation previously established.

In a foregoing proposition, it was shown that of the angles made by a

B D falls upon them, the exterior angle E C D is equal to the interior and opposite angle A B C;

line cutting two parallel lines, the exterior is equal to the interior and opposite. Here there are two parallel lines and a line cutting them; and the cognition which the demonstration expresses is, that the relation between lines and angles which held before, holds now—that this is a like relation, an equal relation.

but the angle A C E was shown to be equal to the angle B A C; therefore the whole exterior angle A C D, is equal to the two interior and opposite angles C A B, A B C.

Immediate intuitions: first, that the whole is equal to its parts; and second, that things which are equal to the same thing are equal to each other. Which last, as we shall see at a future stage, is an intuition of the equality of two relations.

"To these angles add the angle A C B; then the angles A C D, A C B are together equal to the three angles C B A, B A C, A C B.

An intuition that when to equal magnitudes the same magnitude is added, the sums are equal: an intuition which is itself a consciousness of the equality of two relations—the relation that subsists between the magnitudes before the addition is made, and the relation that subsists after it is made.

"But the angles A C D, A C B, are together equal to two right angles;

In a previous case it was ascertained that the angles which a straight line made with another straight line upon one side of it, were either two right angles, or equal to two right angles; and the thing now perceived is, that the relation between lines and angles in this case, is exactly like the relation in that case—in other words, the two relations are equal.

therefore also the angles C B A, B A C, A C B, are together equal to two right angles.

"Therefore if a side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles; and the three interior angles of every triangle are equal to two right angles. Q.E.D."

An intuition that things which are equal to the same thing are equal to each other; which, as before hinted, is itself known through an intuition of the equality of two relations.

An intuition that the relation between lines and angles found to subsist in this triangle, subsists in any triangle, in all triangles—that the relation in every other case is equal to the relation in this case.

Thus in each step by which the special conclusion is reached, as well as in the step taken from that special conclusion to the general one, the essential operation gone through is the establishment in consciousness of the equality of two relations. And as, in each step, the mental act is undecomposable—as for the assertion that any two such relations are equal, no reason can be assigned save that they are perceived to be so; it is manifest that the whole process of thought is thus expressed.

§ 283. Perhaps it will be deemed needless to prove that each step in an algebraic argument is of the same nature; since it has been shown that the axiom—Relations which are equal to the same relation are equal to each other, twice involves an intuition of the above-described kind; and since the implication is, that reasoning which proceeds upon this axiom is built up of such intuitions. But it may be well definitely to point out that only in virtue of such intuitions do the successive transformations of an equation become allowable. Unless it is perceived that a certain modification

made in the form of the equation, leaves the relation between its two sides the same as before—unless it is seen that each new relation established is *equal* to the foregoing one, the reasoning is vicious. A convenient mode of showing that the mental act continually repeated in one of these analytical processes is of the kind described, is suggested by an ordinary algebraic artifice. When a simplification may be thereby achieved, it is usual to throw any two forms of an equation into a proportion—a procedure in which the equality of the relations is specifically asserted. Here is an illustration: not such an one as would occur in practice, but one that is simplified to serve present purposes.

$$2xy = y^2$$
$$2x = y$$
$$2xy : y^2 :: 2x : y$$

or, as it is otherwise written

$$2xy : y^2 = 2x : y$$

and if proof be needed that this mode of presenting the facts is legitimate, we at once obtain it by multiplying extremes and means; whence results the truism—

$$2xy^2 = 2xy^2.$$

This clearly shows that the mental act determining each algebraic transformation, is one in which the relation expressed by the new form of the equation is recognized as equal to the relation which the previous form expresses.

CHAPTER IV.

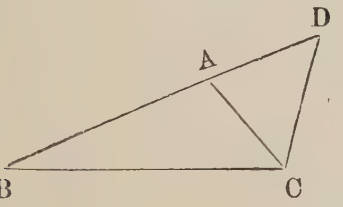
IMPERFECT AND SIMPLE QUANTITATIVE REASONING.

§ 284. Ability to perceive equality implies a correlative ability to perceive inequality: neither can exist without the other. But though inseparable in origin, the cognitions of equality and inequality, whether between things or relations, differ in this; that while the one is definite the other is indefinite. There is but one equality; but there are numberless degrees of inequality. To assert an inequality involves the affirmation of no fact, but merely the denial of a fact; and therefore, as positing nothing specific, the cognition of inequality can never be a premiss to any specific conclusion.

Hence, reasoning which is *perfectly* quantitative in its results, proceeds *wholly* by the establishment of equality between relations, the members of which are either equal or one a known multiple of the other. Conversely, if any of the magnitudes standing in immediate relation are neither directly equal nor the one equal to so many times the other; or if any of the successive relations which the reasoning establishes are unequal; the results are *imperfectly* quantitative. The truth is illustrated in that class of geometrical theorems in which it is asserted of some thing that it is greater or less than some other; that it falls within or without some other; and the like. Let us take as an example the proposition—"Any two sides of a triangle are together greater than the third side."

"Let A B C be a triangle; any two sides of it are, together, greater than the third side; namely, B A, A C, greater than B C; and A B, B C, greater than A C; and B C, C A, greater than A B.

"Produce B A to D, and make A D equal to A C; and join D C.



"Because D A is equal to A C, the angle A D C is equal to the angle A C D;

A relation equal to a previously-established relation.

but the angle B C D is greater than the angle A C D;

An immediate intuition of inequality.

therefore the angle B C D is greater than the angle A D C.

An immediate intuition of the equality of two relations of inequality, which have one term in common, and the other terms equal.

"And because the angle B C D is greater than the angle B D C, and that the greater side is opposite to the greater angle, the side D B is greater than the side B C;

A relation equal to a previously established relation.

but D B is equal to B A, A C;

An immediate intuition that when to two magnitudes standing in the relation of equality, the same magnitude is added, the resulting relation equals the original relation.

therefore B A, A C are greater than B C.

"In the same manner it may be demonstrated that the sides A B, B C are greater than C A, and B C, C A greater than A B."

An immediate intuition of the equality of two relations of inequality which have one term in common, and the other terms equal.

The relations subsisting in other cases are equal to the relation subsisting in this case.

It will be observed that here, though the magnitudes dealt with are unequal, yet the demonstration proceeds by showing that certain relations among them are equal to certain other relations: though the primary relations (between quantities) are those of inequality, yet the secondary relations (between relations) are those of equality. And this holds in the majority of imperfectly-quantitative arguments. Though, as we shall see by and by, there are cases in which both the magnitudes and the relations are unequal, yet they are comparatively rare; and are incapable of any but the simplest forms.

§ 285. Another species of imperfectly-quantitative reasoning occupies a position in mathematical analysis, like that which the foregoing species does in mathematical synthesis. The ordinary algebraic inequation supplies us with a sample of it. Thus, if it is known that $a + \frac{x^2}{\sqrt{y}}$ is less than $x + x\sqrt{y}$, the argument instituted is as follows:—

$$\begin{aligned} a + \frac{x^2}{\sqrt{y}} &< a + x\sqrt{y} \\ \frac{x^2}{\sqrt{y}} &< x\sqrt{y} \\ x^2 &< xy \\ x &< y. \end{aligned}$$

In this case, as in the case of equations, the reasoning proceeds by steps of which each tacitly asserts the equality of the new relation to the relation previously established, with this difference, that instead of the successive relations being relations of equality, they are relations of inferiority. The general process of thought, however, is the same in both. This will be obvious on considering that as the inferiority of x to y can be known only by deduction from the inferiority of $a + \frac{x^2}{\sqrt{y}}$ to $a + x\sqrt{y}$; and as it can be so known only by the intermediation of other relations of inferiority; the possibility of the argument depends on the successive relations being recognized as severally equal. It is true that these successive relations need not be specifically equal; but they must be equal in so far as they are defined. In the above case, for example, the original form of the inequation expresses a relation in which the second quantity bears a greater ratio to the first, than it does in the form which follows; seeing that when equals are taken from unequals, the remainders are more unequal than before. But though in the *degree* of inferiority which they severally express, the successive relations need not be equal, they must be equal in so far as being relations of inferiority goes; and this indefinite inferiority is all that is predicated either in premiss or conclusion.

Here, too, should be specifically remarked the fact hinted in a previous chapter; namely, that the reasoning by which an inequation is worked out, palpably proceeds on the intuition that relations which are equal to the same relation are equal to each other. The relations being those of inequality, the filiation of the last upon the first can only thus be explained; and the parallelism subsisting between inequations and equations, in respect of the mental acts gone through in solving them, confirms the conclusion before reached that in equations this intuition is involved, though less manifestly.

Of imperfect quantitative reasoning, the lowest type is that in which the successive relations are known only as relations of inequality—are presented in a way which does not define them as either those of superiority or inferiority. For instance :—

$$\frac{x^2}{y} \text{ is unequal to } y$$

$$x^2 \text{ is unequal to } y^2$$

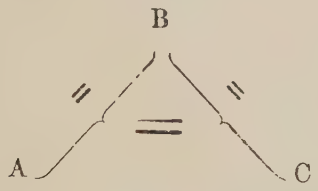
$$x \text{ is unequal to } y.$$

In this case the deductive process is the same as before. The successive relations are perceived to be alike in respect to their inequality, though it is not known whether the antecedents or the consequents are the greater. There is a definite co-ordination of the successive relations, though each relation is defined to the smallest possible extent.

§ 286. Incidentally, much has been implied respecting simple quantitative reasoning throughout the foregoing analyses. The steps into which every compound quantitative argument is resolvable, are simple quantitative arguments; and we have already found that each of them involves the establishment of equality or inequality between two relations. It will be convenient, however, to consider by themselves a class of simple quantitative arguments which are of habitual occurrence: some of them axioms; some of them nearly allied to axioms.

Let us commence with the familiar one—"Things which are equal to the same thing are equal to each other." By reasoning like that already used in an analogous but more complex case, it may be shown that this axiom expresses an intuition of the equality of two relations. Thus, putting A, B and C, as the three magnitudes, it is clear that if A and C are contemplated by themselves in immediate succession, their equality cannot be recognized; since it is only because equality to B is common to the two that they

can be known as equal. If, on the other hand, B is interpolated in consciousness, and the three are contemplated serially—A, B, C, or C, B, A,—then A and C do not occur in the juxtaposition implied by consciousness of their equality. There remains no alternative but that of contemplating them in pairs, thus:—



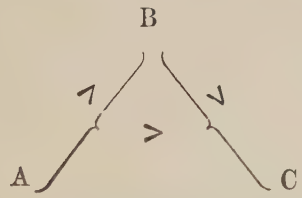
When A and B are united together in the single concept —a relation of equality; and when C and B are united into another such concept; it becomes impossible to recognize the equality of these two relations of equality which possess a common term, without the equality of the other terms being involved in the intuition.

That the mental act is of the kind described, will be made clear by taking a case in which some of the magnitudes dealt with have ceased to exist. Suppose A to represent a standard measure preserved by the State; and let a surveyor be in possession of a measure B, which is an exact copy of the original one A. Imagine that in the course of his survey the measure B is broken; and that in the meantime the building containing the standard measure A, has been burnt. Nevertheless, by purchasing another measure C, which had also been made to match the standard A, the surveyor is enabled to complete his work; and knows that his later measurements will agree with his earlier ones. By what process of thought does he perceive this? It cannot be by comparing B and C; for one of these was broken before he got the other. Nor can it be by comparing them serially—B, A, C, and C, A, B; for two of them have ceased to exist. Evidently, then, he thinks of B

and C as both copies of A: he contemplates the *relations* in which they respectively stood to A; and in recognizing the sameness or equality of these relations, he unavoidably recognizes the equality of B and C. Here let us notice a fact having an important bearing, not only on this, but on endless other cases—the fact, namely, that the mind may retain an accurate remembrance of a *relation*, when it is unable to retain an accurate remembrance of the *things* between which the relation subsisted. To vary the above illustration—suppose a surveyor has had opportunities, at the respective times when he bought them, of comparing the measures B and C with the standard A. It becomes possible for him, at any time afterwards, to remember with precision the relation of equality in which B stood to A: he can see in thought that exact agreement which they displayed when placed side by side. But he cannot remember the magnitudes themselves with anything like this precision. And now observe the implication. When two objects that have not been seen in juxtaposition are remembered, an approximate idea of their relative magnitudes may be formed, if they are markedly different; but if they are nearly of a size, the judgment is as likely to be wrong as right in deciding which is the greater. If, then, two magnitudes separately observed, cannot afterwards be represented in consciousness so distinctly that their equality or inequality can be determined; and if, on the other hand, a relation of equality that was once ascertained by juxtaposing two magnitudes *can* be represented in consciousness with perfect distinctness, and recognized as equal to some other relation of equality; it becomes manifest that, in cases like the above, the truth perceived *cannot* be reached by remembering the magnitudes, but *can* be reached by remembering the relations.

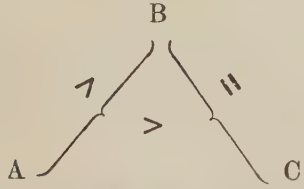
Divergent from this original type are certain intuitions in which the thing known is the relation, not between two relations of equality having a common term, but between

two relations of inequality having a common term. Thus, if A is greater than B, and B greater than C, then A is greater than C; and conversely if they are severally less instead of greater. The act of thought may be symbolized thus :—



The relation A to B being given as a relation of superiority, while that of C to B is given as a relation of inferiority, it is known that the relation A to B is greater than the relation C to B; and as the term B is common to the two relations, the intuition that the relation A to B is greater than the relation C to B, cannot be formed without involving the intuition that A is greater than C.

Again, if A is greater than B, and B is equal to C; we know that A is greater than C. And if the first relation is one of equality and the second is one of inequality, there is a kindred intuition. In these cases, or rather in the first of them, we may express the mental act thus :—



Here, as before, the magnitude B being common to both, the relation A to B cannot become known as greater than the relation C to B without the superiori y of A to C being known. Two relations having a common term cannot be conceived unequal, unless the remaining terms are unequal And just as two magnitudes placed side by side, cannot be perceived unequal without its being at the same time per-

ceived which is the greater; so, of two conjoined relations, one cannot be perceived greater than the other without its being at the same time perceived which includes the greater magnitude.

§ 287. Of simple quantitative intuitions embodied in axioms, or capable of being so embodied, we have next to consider the class in which not three magnitudes but four are involved. On such axioms proceed the successive transformations of an equation.

Among them the most familiar are these:—The sums of equals are equal. If equals are taken from equals the differences are equal. If equals are multiplied by equals the products are equal. If equals are divided by equals the quotients are equal. These are of course accompanied by axioms expressing converse intuitions such as:—If to equals unequals are added the sums are unequal. If equals are divided by unequals the quotients are unequal, etc. Some of the intuitions of this order are more complex. I may name those by which it is known that if from unequals equals are taken, the remainders are more unequal; and, conversely, that if to unequals equals are added, the sums are less unequal. To such generic cases may be added the specific ones in which the first pair of unequals being known to stand in a relation of superiority, the second pair are known to stand in a still greater relation of superiority, or a less relation, according to the operation performed; and similarly when the relation is one of inferiority. Thus,

$$\left.\begin{matrix} A + c \\ \vee \\ B + c \end{matrix}\right\} < \left\{\begin{matrix} A \\ \vee \\ B \end{matrix}\right.$$

if $A + c$ is greater than $B + c$; then, in a still higher de-

gree is A greater than B—an intuition which may be expressed by the foregoing symbol.

For present purposes it is needless to detail the varieties belonging to this class. It will suffice to remark, alike of these cases in which the thing perceived is the inequality of two relations, and of the antithetical cases in which the equality of two relations is perceived, that they differ from the previous class in this; that the relations are not conjoined ones but disjoined ones. Throughout the previous class, of which the simplest type is the axiom—"Things which are equal to the same thing are equal to each other," there is invariably one term common to the two relations; while throughout this class, of which as a typical sample we may take the axiom—"If equals be added to equals the sums are equal," the compared relations have no term in common. Hence in this second series, the relations being perfectly independent and distinct, the mental processes into which they enter are more readily analyzable. It is at once manifest that each of the axioms above given, involves an intuition of the equality or inequality of two relations; and, indeed, the fact is more or less specifically stated throughout. In each case there is a certain relation, the terms of which are modified after a specified manner; and there is then an assertion that the new relation is or is not equal to the old one—an assertion which, being based on no argument, expresses an intuition.

§ 288. One further fact respecting these two groups of intuitions remains to be noticed. They have a common root with those which proportions express. The one group is related in origin to that species of proportion in which the second of three magnitudes is a mean between the first and third; and the other group to that species in which the proportion subsists between four separate magnitudes. Thus the axiom—"Things which are equal to the same thing are

equal to each other," may, if we call the things A, B and C, be written thus :—

$$A : B :: B : C.$$

And again, the axiom—"The sums of equals are equal," may, if we put A and B for the first pair of equals, with C and D for the second pair, be expressed thus :—

$$A : B :: A + C : B + D.$$

The intuitions by which proportions are established, differ from the majority of the foregoing intuitions simply in their greater definiteness—in their complete quantitativeness. The two compared relations are always exactly equal, whatever the magnitudes may be—are not joined by the indefinite signs meaning greater than or less than; and when the proportion is expressed numerically, it not only implies the intuition that the two relations are equal, but the figures indicate what multiple, or submultiple, each magnitude is of the others.

CHAPTER V.

QUANTITATIVE REASONING IN GENERAL.

§ 289. Quantitative Reasoning involves the three ideas—coextension, coexistence, and connature;* or to speak less accurately but more comprehensibly—sameness in the quantity of space occupied, sameness in the time of presentation to consciousness, and sameness in kind. It involves these either positively by asserting them, or negatively by denying them. This proposition calls for an expanded statement.

The germ out of which Quantitative Reasoning grows—the simple intuition of the equality of two magnitudes, necessarily involves all these ideas. There can be no comparison between magnitudes unless they are of the same kind; and their coextension cannot be perceived unless they are coexistent. It is thus with positively-quantitative geometry in general. Each of its propositions predicates the coextension or non-coextension of two or more connatural things which coexist; or the coexistence of certain things asserted to be coextensive, or the reverse, with certain other things known to be coextensive, or the reverse. And its demonstrations proceed by asserting that certain coexistent, connatural things are invariably coextensive, or the reverse; or that certain connatural and

* I coin this word partly to avoid an awkward periphrasis; and partly to indicate the kinship of the idea signified, to the ideas of coexistence and coextension. As we have already in use the words *connate* and *connatural*, the innovation is but small; and will, I think, be sufficiently justified by the requirement.

coextensive things invariably coexist with certain other things. When the propositions are numerical, and when, as frequently happens in Algebra and the Calculus generally, *duration* is one of the elements dealt with, it would appear that coexistence is not involved; and further, that when *force* and *value* are the other elements of the question, there is not even any implication of coextension. These, however, are illusions resulting from the abstract character of numerical symbols. Representing equal units, and groups of equal units, of any order whatever; and being, as it were, created at any moment for the purposes of calculation; numerical symbols seem, at first sight, independent alike of Space and Time. The fact, however, is exactly the reverse. On tracing them back to their origins, we find that the units of Time, Force, Value, Velocity, &c., which figures may indiscriminately represent, were at first measured by equal units of Space. The equality of times becomes known either by means of the equal spaces traversed by an index, or the descent of equal quantities (space-fulls) of sand or water. Equal units of weight were obtained through the aid of a lever having equal arms (scales). The problems of Statics and Dynamics are primarily soluble, only by putting lengths of lines to represent amounts of forces. Mercantile values are expressed in units which were at first, and indeed are still, definite weights of metal; and are therefore, in common with units of weight, referable to units of linear extension. Temperature is measured by the equal lengths marked alongside a mercurial column. Thus, abstract as they have now become, the units of calculation, applied to whatever species of magnitudes, do really stand for equal units of linear extension; and the idea of coextension underlies every process of mathematical analysis. Similarly with coexistence. Numerical symbols are, it is true, purely representative; and hence may be regarded as having nothing but a fictitious existence. But one of two things must be

admitted respecting the reasoning processes carried on by means of them. Either these processes imply a conscious reference to the things symbolized—in which case the equalities predicated are really those previously observed between coexistent things; or else the things symbolized cease to be thought of, and the relations among the symbols are alone considered—in which case these symbols require to be made coexistent to consciousness before their relations can be determined. In fact, the phenomena of motion and sequence can be treated quantitatively, only by putting coexistent magnitudes to represent magnitudes that do not coexist. The relative lengths of two times, not being ascertainable directly, has to be indirectly ascertained by comparing the spaces which a clock-finger traverses during the two times; that is, by comparing coexistent magnitudes. Hence, regarding it in the abstract, we may say that the Calculus in general is a means of dealing with magnitudes that do not coexist, or are not homogeneous, or both, by first substituting for them magnitudes that do coexist and are homogeneous, and afterwards re-translating these into their original forms.

That perfect quantitative reasoning deals exclusively with intuitions of the coextension of coexistent magnitudes which are connatural, will, however, be most clearly seen when it is remarked that the intuitions of coextension, of coexistence, and of connature, are the sole perfectly definite intuitions we can frame. On placing two equal lines side by side, we can perceive with precision that they are equal; but we cannot, if one is greater than the other, perceive with like precision how much greater it is. Our only mode of precisely determining this, is to divide both into small *equal* divisions, of which the greater contains so many and the less so many: we have to fall back on the intuition of coextension. Again, while we can know with exactness that two things coexist, we cannot, when one thing follows another, know with like exactness the interval of time be-

tween them. Definitely to ascertain this, we use a scale of time made up of coextensive units of space. Once more, we recognize with perfect definiteness, equality of nature in those things which admit of quantitative comparison. That straight lines are homogeneous, and can stand to one another in relations of greater and less, though they cannot so stand to areas or cubic spaces; that areas are connatural with areas, and cubic spaces with cubic spaces; that such and such are magnitudes of force, and such and such are magnitudes of time—these are intuitions that have as high a degree of accuracy as the foregoing ones. Beyond these three orders of intuitions, however, we have none that are perfectly definite. Our perceptions of degree and quality in sound, colour, taste, smell; of amount in weight and heat; of relative hardness; of relative duration; are in themselves inexact. Hence, as we know that by quantitative reasoning of the higher orders, perfectly definite results are reached; it follows that the intuitions out of which it is built must be exclusively those of coexistence, connature, and coextension.

Here, to show the various combinations into which these intuitions enter, and also to bring into view sundry facts not yet noticed, let me group in their ascending order the successive forms which quantitative reasoning assumes. Certain unavoidable repetitions will, I think, be justified by the clearer comprehension to be given

§ 290. The intuition underlying all quantitative reasoning is that of the equality of two magnitudes. Now the immediate consciousness that—

$$A = B$$

implies three things:—First, that A and B are coexistent; for otherwise, they cannot be so presented to consciousness as to allow of a direct recognition of their equality. Second, that they are magnitudes of like kind, that is, connatural or homogeneous; for if one be a length and the other an area,

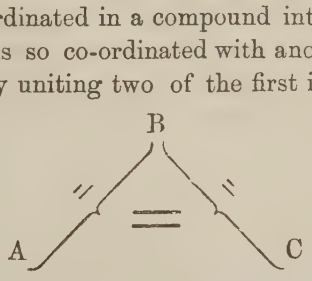
no quantitative relation can exist between them. Third, that they are not *any* homogeneous magnitudes, but are magnitudes of linear extension; seeing that these alone admit of that perfect juxtaposition by which exact equality must be determined—these alone permit their equality to be tested by seeing whether it will merge into identity, as two equal mathematical lines placed one upon the other do —these alone exhibit that species of coexistence which can lapse into single existence. Thus the primordial quantitative idea unites the intuitions of coextension, coexistence, and connature in their most perfect forms.

To recognize the negation of this equality—to perceive that A is unequal to B—or, more explicitly, to perceive either that—

$$A > B, \quad \text{or} \quad A < B$$

involves no such stringent conditions. It is true that, as before, A and B must be connatural magnitudes. But it is no longer necessary that they should be coexistent; nor that they should be magnitudes of linear extension. Provided the superiority or inferiority of A to B is considerable, it can be known in the absence of one or both; and can be known when they are magnitudes of area, bulk, weight, time, velocity, &c.

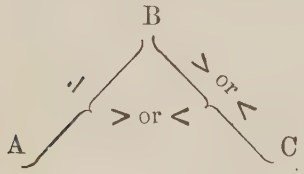
The simplest act of quantitative reasoning, which neither of these intuitions exhibits when standing alone, arises when the two are co-ordinated in a compound intuition; or when either of them is so co-ordinated with another of its own kind. When, by uniting two of the first intuitions thus—

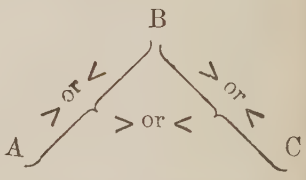


we recognize the equality of A and C, it is requisite, as before, that if the equalities of A to B, and B to C are to be

known immediately, the magnitudes shall be those of linear extension, though, if the equalities have been mediately determined, the magnitudes may be any other that are homogeneous; but it is no longer necessary that all of them shall coexist. At one time A must have coexisted with B; and at one time B must have coexisted with C; but the intuitions of their equalities having once been achieved, either at the same time or separate times, it results from the ability we have to remember a specific relation with perfect exactness, that we can, at any subsequent time, recognize the equality of the relations A to B and B to C, and the consequent equality of A and C; though part, or even all, of the magnitudes have ceased to exist.

By uniting the first and second intuitions, and by uniting the second with another of its own kind, we obtain two compound intuitions, formulated as follows :—



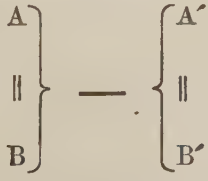


In the first of these cases it is requisite, when the relations are immediately established, that the magnitudes be linear; but not so if the equality of A and B has been mediately established; and while A and B must have coexisted, it is not necessary that B and C should have done so. In the second case the magnitudes need not be linear; but, if the inequalities are considerable, may be of any order. Further, it would at first sight appear that they need none of them be coexistent. But this is not true. For if the superiority or inferiority of A to B and of B to C is so great that it can be perceived by comparing the remembrances of them, then the superiority or inferiority of A to C can be similarly perceived without the intermediation of

B; and the reasoning is superfluous. The only cases to which this formula applies, are those in which the inequalities are so moderate that direct comparison is required for the discernment of them; whence it follows that each pair of magnitudes must have been at one time coexistent.

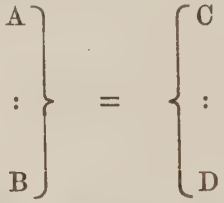
The next complication, characterizing all quantitative reasonings save these simplest and least important kinds just exemplified, arises when, in place of conjoined relations, we have to deal with disjoined relations—when the compared relations instead of having one term in common have no term in common. Wherever there are four magnitudes instead of three, sundry new laws come into force; the most important of which is, that the magnitudes need no longer be all of the same order. In every one of the foregoing cases, we have seen that while the intuition of coexistence is sometimes not immediately involved but only mediately so, even where the judgment reached is perfectly quantitative; and while, where the judgment is imperfectly quantitative, the intuition of coextension is not involved, save as the correlative of non-coextension; the intuition which *is* uniformly involved is that of the connature of the magnitudes—their homogeneity, their sameness in kind. Without this no one of the judgments given is possible. But with disjoined relations it is otherwise. The four magnitudes may be all homogeneous; or they may be homogeneous only in pairs, either as taken in succession or alternately. Let us consider the resulting formulæ.

When all the magnitudes are homogeneous we have for the first group of cases the symbol—

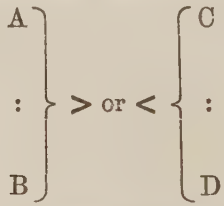


in which each of the disjoined relations is one of equality,

and the second is some transformation of the first. This, as before shown, represents the mental act taken in every step of an equation; and stands for the several axioms—When equals are added to, subtracted from, multiplied by, or divided by, equals, the results are equal. For the second group of cases we have the symbol—



in which each of the relations is one of inequality. This comprehends all cases of proportion: whether they be the numerical ones in which the degrees of inequality are definitely expressed; or the geometrical ones (as those subsisting between the sides of similar triangles) in which the degrees of inequality, though known to be alike, are not definitely expressed. For the third group of cases, forming the antithesis to the two preceding groups, and being but imperfectly quantitative, we have the symbol—



which represents such general truths as that if equals be taken from unequals the remainders are more unequal; that if to equals unequals be added, the sums are unequal; and so forth. Respecting these three groups of cases in which the magnitudes are all homogeneous, it needs only be added that the equality or inequality asserted between the two pairs, always refers directly or indirectly to the space-relations of their components, and not to their time-relations.

Passing to the class of disjunctive pairs of relations in which the several magnitudes are not all homogeneous, we find that the equality predicated between the relations may refer either to comparative extension or comparative existence. The first group of them may be symbolized thus :—

$$\left.\begin{matrix} A \\ \\ B \end{matrix}\right\} = \left\{\begin{matrix} c \\ : \\ d \end{matrix}\right.$$

so as to indicate the fact that the magnitudes of the first relation are of one species, while those of the second relation are of another species. It comprehends cases in which one line is to another line as one area to another area, or in which a bulk is to a bulk as a weight to a weight—cases like those in which it is seen that triangles of the same altitude are to each other as their bases, or that the amounts of two attractions are to each other as the masses of the attracting bodies. Here it is manifest that though the first pair of magnitudes differs in kind from the second pair, yet the antecedent and consequent of the one bear to each other the same quantitative relation as those of the other; and hence the possibility of ratiocination. The second group of cases belonging to this class may be thus formulated.

$$\left.\begin{matrix} A \\ : \\ b \end{matrix}\right\} = \left\{\begin{matrix} C \\ : \\ d \end{matrix}\right.$$

Here each relation consists of two heterogeneous magnitudes, as a line and an angle; but the two antecedents are of the same nature and the two consequents are of the same

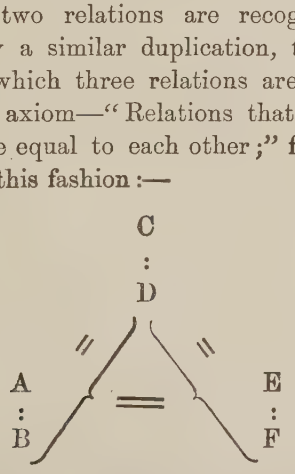
nature. Neither of the compared relations can be a quantitative one; since in neither have the components that connature implied by the assertion of relative magnitude. Hence the two relations can be equal only in respect of the *coexistence* of their elements; and, as it would seem, considerations of quantity are no longer involved. There are conditions, however, under which this form represents reasoning that is truly quantitative; namely, when the coexistence pre-supposes certain defined quantitative relations by which the heterogeneous magnitudes are indirectly bound together. Thus, when the theorem—"The greater side of every triangle has the greater angle opposite to it," is quoted in the proof of a subsequent theorem, the act of thought implied is of the kind above symbolized. The greater side (A) of a triangle, has been found to stand in a special relation of coexistence with the greater angle (*b*); and in some other triangle the greater side (C) and greater angle (*d*) are perceived to stand in the *same* or an *equal* relation. This relation is not simply that of coexistence: it is coexistence in certain respective positions. And though there can be no *direct* quantitative relation between a side and an angle, yet, by being contained between the two lesser sides, the greater angle is put in *indirect* quantitative relation with the greater side. It may be held, however, that in this, as in the innumerable like cases which occur in geometrical reasoning, A, *b*, C, and *d* should be severally regarded rather as relations between magnitudes, than as magnitudes themselves. To elucidate this question let us consider the theorem—"The angle in a semicircle is a right angle." Here the word "semicircle" denotes definitely quantitative relations—a curve all parts of which are *equi*distant from a given point, and which has its extremities joined by a straight line passing through that point. The words "angle in a semicircle," denote further quantitative relations: negatively quantitative if not positively quantitative. And the thing asserted is, that

along with this group of quantitative relations coexists that other group of quantitative relations which the term "right angle" denotes between two lines containing it. Taking this view, the reasoning will stand thus :—

DEMONSTRATED CASE.				ANY OTHER CASE.	
(The relations constituting the angle in this semicircle)	A	=	C	(The relations constituting the angle in that semicircle)
(Coexist with)	:	=	:	(Coexist with)
(The relations constituting a right angle.)	b	=	d	(The relations constituting a right angle.)

Such seems to be the more correct analysis of those kinds of quantitative reasoning above described, in which the antecedents are not homogeneous with the consequents.

The only further complication needing consideration here, is the one arising when, instead of *two* equal relations, we have to deal with *three*. As from that first simple intuition in which two magnitudes are recognized as equal, we passed, by union of two such intuitions, into a compound one involving three magnitudes; so from the foregoing cases in which two relations are recognized as equal, we now pass, by a similar duplication, to the still more complex case in which three relations are involved. This brings us to the axiom—"Relations that are equal to the same relation, are equal to each other;" formulated, as we before saw, after this fashion :—



In which symbol it will be seen that each pair of relations

is united in thought, after the same general manner as any of the pairs lately treated of. The various modifications of this form which result when the relations are unequal, it is unnecessary to detail. And it is also unnecessary to dwell on those yet more complicated forms which result when this conjunctive arrangement is replaced by a disjunctive arrangement—when, in place of three relations, we have to deal with four; as in the case of the axiom given at the outset (§ 277)—"Relations which are severally equal to certain other relations that are unequal to each other, are themselves unequal." The process of evolution has been sufficiently exemplified to render this, and the allied intuitions, readily comprehensible.

All that needs further be done is to point out how, yet successive developments, we have advanced from a simple intuition of the equality or inequality of two magnitudes, to a highly complex intuition of the equality or inequality of relations between relations.

§ 291. Quantitative reasoning thus followed in its genesis, shows us that, either mediately or immediately, it always involves, in their positive or negative forms, some or all of the ideas—sameness in the nature of its magnitudes; sameness in their quantity; sameness in their time of presentation to consciousness; and sameness in degree between relations of the same nature subsisting among them. It will be well, finally, to remark that we may see, even *à priori*, the impossibility of carrying on any quantitative reasoning, save by intuitions of the equality or inequality of relations.

It is the purpose of a quantitative argument to determine with definiteness the relative magnitudes of things. If these things stand to each other in such wise that their relative magnitudes are known by simple intuition, argument is not involved. There can be argument, therefore, only when they are so circumstanced as not to be directly comparable.

Hence their relative magnitudes, if determined at all, must be determined by the intermediation of magnitudes to which they are comparable. The unknown quantitative relation between A and E, can be ascertained only by means of some known quantitative relations between each of them and B, C, D; and it is the aim of every mathematical process to find such intermediate known relations as will bring A and E into quantitative comparison. Now no contemplation of magnitudes alone can do this. We might go on for ever considering B, C, and D, in their individual capacities, without making a step towards the desired end. Only by observing their modes of dependence can any progress be made. If A and E are in an unknown quantitative *relation* which we desire to determine, we can determine it only as being equal or unequal to certain other *relations*, which we know mediately or immediately. There is no way even of specifically expressing the relation save by this means. The ascertaining what a thing *is* or *is not*, signifies the ascertaining what things it is like or not like—what class it belongs to. And when, of the previously unknown relation between A and E, we say we have discovered it, completely or partially, our meaning is that we find it to be the same, or not the same, as some relation which is known. Hence it results, *à priori*, that the process of quantitative reasoning must consist in the establishment of the equality or inequality of relations.

CHAPTER VI.

PERFECT QUALITATIVE REASONING.

§ 292. Thus far we have dealt with reasoning which has for its fundamental ideas, coextension, coexistence, and connature; and which proceeds by establishing cointension* in degree, between relations that are connatural. We have now to consider a kind of reasoning in which the idea of coextension forms no necessary element: that, namely, by which we determine the coexistence or non-coexistence of things, attributes, or relations, that are connatural with certain other things, attributes, or relations. It was pointed out that the intuitions of coextension, coexistence, and connature, are the only perfectly definite intuitions we are capable of; and the only intuitions, therefore, through which we can reach exact conclusions. One class of these

* The words *tense*, *tension*, *intense*, *intension*, are already in use. *Intension* being synonymous with *intensity*, *cointension* will be synonymous with *cointensity*; and is here used instead of it because the parallelism with *coextension* is thus indicated. The propriety of calling relations more or less *intense*, according to the degrees of difference between their terms, may not be at first sight apparent. All quantitative relations, however, save those of equality, involve the idea of *contrast*—the relation of 5 : 1 being called greater than the relation of 2 : 1, because the contrast betwen 5 and 1 is greater than the contrast between 2 and 1. And since contrast is habitually spoken of as *weak* or *strong*, as *feeble* or *intense*, the word *intension* seems a fit one to express the *degree* of any relation as distinguished from its *kind*. *Cointension* is consequently here chosen, to indicate the equality of relations in respect of the contrasts between their terms.

conclusions, in which the *quantity* of certain existences of determinate quality is predicated, has been examined. It remains to examine a class in which the thing predicated is either the *quality* of certain determinate existences, or the existence of certain determinate *qualities*.

The last chapter incidentally exhibited the near connexion between these kinds of reasoning. It was shown that when of two compared relations, each consists of heterogeneous magnitudes which admit of no quantitative comparison, the two relations can be considered equal, only in respect to the coexistence of the components of each. We saw that many geometrical theorems simulate this form; expressed by the symbol—

$$\left.\begin{matrix} A \\ : \\ b \end{matrix}\right\} = \left\{\begin{matrix} C \\ : \\ d \end{matrix}\right.$$

the fact predicated being the coexistence of C and *d*, standing in the same relation as A and *b*, which were proved coexistent; (say the equiangularity and equilateralness of a triangle.) As was pointed out, however, the terms of each relation are, in these cases, not really heterogeneous magnitudes, but heterogeneous relations among magnitudes that have definite though indirect quantitative connexions. When, contrariwise, the terms of each relation are simple heterogeneous magnitudes, or heterogeneous groups of relations having no implied quantitative connexions, we pass to the order of reasoning now to be treated of; in which equality is asserted of two relations that are alike in the natures of their terms, and in the coexistence of each antecedent with its own consequent.

Before proceeding I must meet an objection that may be raised to the use of the word *equality* in the sense here given to it. Commonly we apply it only to attributes. We speak

of equal lengths, breadths, areas, capacities; equal times, weights, velocities, momenta; equal temperatures, sounds, colours, degrees of hardness; and we speak of equal ratios or relations, when the terms are magnitudes; but we do not speak of relations of coexistence as equal. Here, however, we are dealing, not with words in their conventional applications, but with the mental acts which words mark; and these, when they are of the same character, must have the same name. The true interpretation of equality is *indistinguishableness*. Distances, and sizes, and weights, we call equal when no differences can be discerned between them. We assert the equality of two ratios — two relations of extension—when the contrast in amount between the first antecedent and its consequent, cannot be distinguished from the contrast in amount between the second antecedent and its consequent. And, similarly, we may assert the equality of two relations of existence, when the one does not differ from the other in respect of time—when each is a relation of *co*existence. As two relations of coextension are properly considered equal, though each of them consists of magnitudes that are unlike in everything but length; so two relations of coexistence may properly be considered equal, though the elements of each are unlike in everything but the period of their presentation to consciousness. Or, to put the matter in an *à priori* form—Every phenomenon, when considered in connexion with any other, must be known either as occurring before it, as being simultaneous with it, or as occurring after it. But all objects of thought, and among others relations of time, may be compared, and their likenesses or unlikenesses recognized. The time-relation of events that occur simultaneously, is different from the time-relation of events that occur one after the other. Two sequences are alike in so far as they are sequences; and each of them is unlike a coexistence. Hence, if there are time-relations so completely alike as to be indistinguishable, they may properly be called

equal. Such time-relations we have in all co-existences. Consequently when, having learnt that certain two attributes invariably coexist, we, in any new case, know that where we see the one we shall find the other; it may as truly be said that the mental act implied is a recognition of the equality of two relations, as when, in similar triangles of which two homologous sides are known, we infer the area of one triangle from that of the other.

§ 293. This being understood, we now pass to those reasonings in which the things asserted are not the co-extensions or non-coextensions of certain coexistences, but either, on the one hand, the coexistence or non-coexistence of certain attributes or groups of attributes, or, on the other hand, the simultaneity or non-simultaneity of certain changes or groups of changes. Reasonings of this order, which, instead of explicitly predicating *both* space-relations and time-relations, explicitly predicate time-relations only, exhibit, in a large group of cases, that same necessity often ascribed exclusively to quantitative reasonings. This group of cases is divisible into two sub-groups; the one including disjoined relations and the other conjoined relations—the one always involving four phenomena and the other only three.

The first of these sub-groups—represented by the formula last given, and, like geometrical reasoning, predicating necessary coexistence, but, unlike it, saying nothing of co-extension — includes the countless cases in which, from certain observed attributes of objects, we infer the presence of certain other attributes that are inseparable from them. When, on feeling pressure against an out-stretched limb, I conclude that there is something before me having extension—when, on seeing one side of an object, I know that there is an opposite side; this order of reasoning is exemplified. Were it not that perpetual repetition has consolidated these cognitions into what may be termed

organic inferences, it would be at once seen they stand on a like footing with those in which the equilateralness of a triangle is known from its equiangularity, when the coexistence of these has once been recognized. Under another head we shall hereafter consider these cases more closely. At present it concerns us only to notice that the mental act implied, is an intuition of the equality of two disjoined time-relations—the one, a generalized relation of invariable coexistence, established by an infinity of experiences having no exception, and therefore conceived as a necessary relation; the other, a particular relation of coexistence, in which one term is not perceived but is implied by the presence of the accompanying term. To formulate an example:—

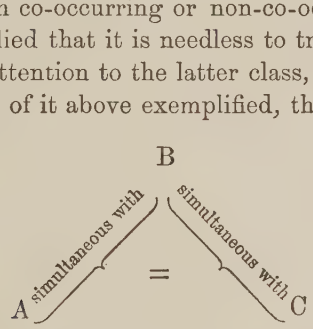
(Tangible substance) A (Universally, or necessarily, coexists with) : (Limiting surfaces) B	}	=	{	a (This mass of rope) : (Coexists with) b (Two ends, which uncoiling it will disclose.)

And similarly in all cases of necessary attributes as distinguished from contingent attributes.*

Of that subdivison of perfect qualitative reasoning which proceeds by recognizing the equality or inequality of conjoined relations, the examples are not abundant. The fact predicated in any one of them is either the coexistence or non-coexistence of certain things, as determined by their known relations to some third thing, or else the simul-

* The choice of letters in this formula needs explanation. By using capitals in the first relation and small letters in the second, I intend to signify, on the one hand, the general or class relation, and, on the other, the particular relation contemplated. Letters of the same names are used to match the fact that the antecedents are homogeneous with the antecedents, and the consequents with the consequents. While the use of roman letters for the antecedents and italic letters for the consequents, implies that the antecedents differ in nature from the consequents—that the two are heterogeneous.

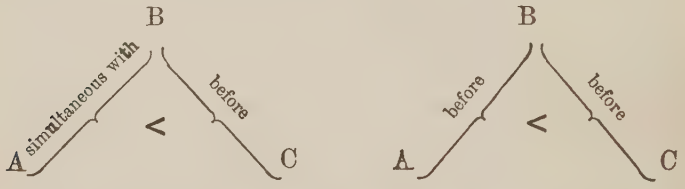
taneity or non-simultaneity of certain events, as determined by their known relations to some third event. If, of two persons together passing the open door of a building, the one sees a barrel of gunpowder inside while the other sees a boy with a light in his hand, it is clear that, on immediately hearing an explosion, the adjacent coexistence of the light with the gunpowder is inferable: the data being that the one observed the adjacent coexistence of the light and the building, while the other observed the adjacent coexistence of the gunpowder and the building. If, again, certain two other persons heard the explosion, and, on comparing notes, found that each was setting out to meet the other at the moment of its occurrence; it is a necessary inference that they set out at the same time. These two classes of cases, dealing respectively with coexistent or non-coexistent things, and with co-occurring or non-co-occurring changes, are so nearly allied that it is needless to treat of them both. Confining our attention to the latter class, we may represent the sub-division of it above exemplified, thus:—



In this symbol the letters stand, not for objects but for events; and the simultaneity of A and C is recognized by an intuition analogous to that by which their equality would be recognized, were they magnitudes both equal to a third.

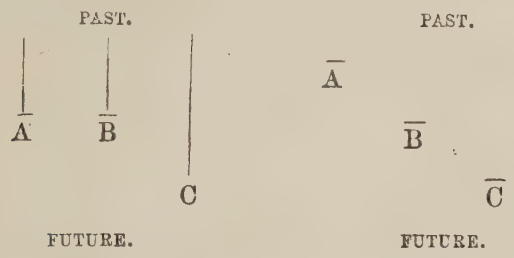
We need not treat in detail the antithetical group of cases in which, of three events, the first and second being known to have occurred simultaneously and the second and third being known to have occurred non-simultaneously, it is inferred that the first did not occur simultaneously with the third. But it will be well to notice the specific cases

in which something more than non-simultaneity is known: those, namely, in which the inference is that one event preceded or succeeded a certain other event. Thus, if A and B go in company to a public meeting, and B on coming away early meets C entering the door; then A, on afterwards hearing of this, knows that he was there before C. Or if, supposing them all to go separately, C on arriving finds B already present, and B tells him that on his (B's) arrival he found A present; then, though he should not see him, C knows that A was there before himself. Using the letters to stand for the events (not the persons), these cases may be represented thus :—



It is needless to detail the possible modifications of these, or to argue at length that the intuitions must be essentially of the kind thus symbolized; for the cases are so obviously analogous to those previously treated of, in which the relations of two unequal magnitudes are known by the intermediation of a third (§ 286), that the explanation there given may, with a change of terms, be used here. Indeed, as this analogy itself suggests, the reasoning exemplified by these last cases is, in a vague sense, quantitative. So long as only coexistence or non-coexistence, simultaneity or non-simultaneity, is asserted, *quantity* of time does not enter into the question. But when the ideas *before* and *after* are involved, there would seem to be a mental comparison of periods, as measured from some common point. The times of particular occurrences are relatively fixed by means of their respective relations to the past—are regarded as farther, or not so far, down the current of time; and can only be thus regarded by comparing the respective intervals between them and occurrences gone by. Whether, as in the

first of the following figures, we represent each of the events A, B, and C, as the terminus to its own particular line of causation; or whether, as in the second, we represent them simply as unconnected occurrences,—



—it is equally manifest that in determining the unknown relation of A and C, by means of their known relations to B, we conceive all their times of occurrence as measured from some past datum. Our course is to compare the lengths of these times, and to recognize the inferiority of the length A to the length C, by means of the known relations they respectively bear to the length B. Where this datum is matters not; for the respective periods measured from it will retain their several relations of equality, inferiority, or superiority, however far back, or however near, it is placed. We get clear proof that the process of thought is as above described, when, from these vaguely-quantitative predications expressed by the words *before* and *after*, we pass to those definitely-quantitative predications reached by using space as a measure of time—when we pass to cases in which, by our clocks, we determine *how much* before or after. On hearing that one event occurred at four and another at five, we know that the first was an hour earlier than the last; and here the names of the hours show us that we recognize the relation of these events in time, by means of their respective relations to twelve o'clock—the datum from which their distances are measured. Similarly with the interval between any two historical events. This we ascertain by severally referring them to the commencement of the Christian era.

And if, to determine specifically the respective positions in time of two occurrences which cannot be brought into direct relation, we habitually compare their distances from some point in the past; it can scarcely be doubted that when we merely determine their positions generally, as before or after, the process gone through is, though vague and almost unconscious, of the same essential nature.

But in whatever way performed, this mental act is necessarily an intuition of the equality or inequality of two relations. If the events A and C stand in just the same time-relation to an event B, or, more strictly—if their time-relations to it are *equal;* then the cognition that they are simultaneous is involved. They cannot be thought of as both occurring at the same time with C, or at equal intervals before it, or after it, without being thought of as simultaneous. Conversely, if the events A and C are known to stand in different time-relations to the event B—if their time-relations to it are *unequal;* then the cognition of their non-simultaneity is involved. Whence it unavoidably follows, that when the difference of the time-relations is expressed more specifically —when the terms *before* and *after* are used—the intuition must be essentially of the same character: be the mode in which the comparison of relations is effected what it may.

§ 294. It seems to me, that in conclusions of this kind only, are involved the axioms which Mr. Mill considers are involved in the syllogism. If we include simultaneity (momentary coexistence) in our idea of coexistence at large, it may be said that all the foregoing cases of conjunctive intuitions, severally recognize one or other of the two general propositions—"Things which coexist with the same thing coexist with one another," and—"A thing which coexists with another thing, with which other a third thing does not coexist, is not coexistent with that third thing." But in no other ratiocinative acts, I think, than those above exemplified, are these self-evident truths tacitly asserted.

That they cannot be the most general forms of the mental process said to be represented by the syllogism, will become manifest on considering that they refer positively or negatively to one time only; whereas the syllogism, as involving in its major premiss an appeal to accumulated experiences, refers to *two* times—to time present and time past. The axiom—"Things which coexist with the same thing coexist with one another," cannot, however often repeated, help us to any knowledge beyond that of the coexistence of an indefinite number of things; any more than the axiom—"Things which are equal to the same thing are equal to one another," can, by multiplied application, do more than establish the equality of some series of magnitudes. But the act of thought which every syllogism professes to represent, besides involving a consciousness of the particular coexistence predicated in the conclusion, involves a consciousness of those before-known coexistences which form the data for that conclusion. Moreover, while such before-known coexistences are implied, it is not requisite that they shall be still knowable. The two terms of the inferred coexistence may alone continue in being. The entities presenting parallel coexistences may have been every one annihilated. How, then, can the mental act by which the predication is effected, be formulated in an axiom which involves *three coexistent terms?*

Has not Mr. Mill been here misled by a verbal ambiguity of a kind which he himself has pointed out, as one "against which scarcely any one is sufficiently on his guard"? Towards the close of Chapter III. of his Logic, he says:—"Resemblance, when it exists in the highest degree of all, amounting to undistinguishableness, is often called identity, and the two similar things are said to be the same. * * * as when I say that the sight of any object gives me the *same* sensation or emotion to-day that it did yesterday, or the *same* which it gives to some other person. This is evidently an incorrect application of the word *same;* for the feeling

which I had yesterday is gone, never to return; what I have to-day is another feeling, exactly like the former perhaps, but distinct from it; * * * * By a similar ambiguity we say, that two persons are ill of the *same* disease; that two persons hold the *same* office." Now, that an *équivoque* of this nature is involved in the above formula, will, I think, be seen on examining the passage which introduces that formula. At page 200 (3rd edition) * Mr. Mill says:—

"The major premiss, which, as already remarked, is always universal, asserts, that all things which have a certain attribute (or attributes) have or have not along with it, a certain other attribute (or attributes). The minor premiss asserts that the thing or set of things which are the subject of that premiss, have *the first-mentioned attribute;* and the conclusion is, that they have (or that they have not) the second. Thus in our former example,

All men are mortal,
Socrates is a man,
therefore
Socrates is mortal,

the subject and predicate of the major premiss are connotative terms, denoting objects and connoting attributes. The assertion in the major premiss is, that along with one of the two sets of attributes, we always find the other: that the attributes connoted by 'man' never exist unless conjoined with the attribute called mortality. The assertion in the minor premiss is that the individual named Socrates possesses *the former attributes;* and it is concluded that he possesses also the attribute mortality."

Both in the general statement and in the example, I have italicised the words in which the misleading ambiguity lies. Let us confine our attention to the example. When it is said that "Socrates possesses *the former attributes,*" the

* In the seventh edition the passage will be found on p. 197. No change of substance or expression has been made in it.

literal meaning of the words, and the meaning Mr. Mill's axiom ascribes to them, is, that Socrates possesses attributes not *exactly like* those connoted by the word "man," but the *same* attributes. Only by this interpretation are the elements of the syllogism reducible to three—1st, the set of attributes possessed by all men and by Socrates; 2nd, the mortality of other men; 3rd, the mortality of Socrates. But in calling the attributes which constitute Socrates a man, the *same* as those by which other men are characterized, is there not a misuse of words parallel to that involved in saying that two persons are ill of the *same* disease? Persons said to have the *same* disease, are persons presenting similar groups of special phenomena not presented by other persons. Objects said to have the *same* attributes (as those of humanity), are objects presenting similar groups of special phenomena not presented by other objects. And if the word *same* is improperly used in the one case, it must be improperly used in the other. This being admitted, it follows that the elements of the syllogism cannot be reduced to less than four. (1). The set of attributes characterizing any or each of the before-known objects united into the class which the major premiss names: which set of attributes must be represented in consciousness either (plurally) as possessed by every sample of the class that can be remembered, or (singularly) as possessed by some one sample of it figured to the mind as a type of the class; and which, therefore, cannot be considered as *less* than one, though it may be considered as *more*. (2). The particular attribute predicated in the major premiss as always accompanying this set of attributes; and which, according as we are supposed to think of it as possessed by several remembered samples of the class, or by a typical sample, may be considered as many, or as one; but cannot be less than one. (3). The set of attributes presented by the individual (or sub-class) named in the minor premiss: which set of attributes being essentially like (not the same as) the first-named

set of attributes, this individual is recognized as a member of the first-named class. (4). The particular attribute inferred as accompanying this essentially-like set of attributes. And if the elements of the syllogism cannot be reduced to less than *four*, it is manifest that the axiom—"Things which coexist with the same thing coexist with one another," which comprehends only *three* things, cannot be the general proposition which each particular syllogism involves. Only to that limited class of conjunctive propositions lately exemplified, can such an axiom apply.*

§ 295. Returning from this parenthetical discussion,

* I regret being obliged still to differ from Mr. Mill on this point. In editions of his *System of Logic* later than that from which I have quoted, he replies to my criticism. Let me deal with a secondary issue before passing to that primary one respecting which, I fear, no reconciliation of view is possible.

Mr. Mill says:—"Mr. Spencer has misunderstood me in another particular. He supposes that the coexistence spoken of in the axiom, of two things with the same third thing, means simultaneousness in time. The coexistence meant is that of being jointly attributes of the same subject. The attribute of being born without teeth, and the attribute of having thirty-two teeth in mature age, are in this sense coexistent, both being attributes of man, though *ex vi termini* never of the same man at the same time." In answer, I would first remark that if in ordinary speech such a use of the word is proper, it may be doubted whether it is proper in Logic, where precision of meaning is essential; and that the literally-true statement of the relation is, that in the infant, toothlessness coexists with *the power of developing* thirty-two teeth at maturity. In the second place, I would point out that if coexistence is to be interpreted in this comprehensive sense, there needs some means of distinguishing between the very dissimilar relations expressed by it. Thus, the proposition that in man rudimentary teeth coexist with rudimentary hair, expresses a literal relation of coexistence. Similarly, when I assert that in man virility coexists with a deep voice, I assert of two attributes that they are simultaneously possessed by the same thing. But if the relation of coexistence may be asserted between all attributes possessed by a man throughout his life, it may be said that rudimentary teeth coexist with a deep voice. The circumstance that we must qualify this proposition by saying that the attribute of having rudimentary teeth in infancy, coexists with the attribute of having a deep voice at maturity, shows that coexistence is here to be understood in a sense qualified by the words infancy and maturity. In the absence of qualifying words (and the axiom we are considering contains none) coexistence must be understood in

there has still to be noticed that species of perfect qualitative reasoning in which the thing predicated is some necessary relation of phenomena in succession. We have already considered cases of unconditional coexistence; and here we have to glance at cases of unconditional sequence.

As, in the first group, we were concerned only with those relations of co-existence the negations of which are inconceivable; so, in this second group, we are concerned only with those relations of antecedence and sequence which it is impossible to think of as other than we know them. To take a case—If, on entering a room, I find in a distant corner the chair which I had previously placed near the

the literal sense in which I have used it; or else, being taken in either sense, confusion must result.

On turning to the main issue, whether the syllogism contains four indispensable elements or only three, I find that Mr. Mill's explanation discloses a difference of view which is fundamental. He says:—"The question between Mr. Spencer and me is merely one of language; for neither of us (if I understand Mr. Spencer's opinions rightly) believes an attribute to be a real thing, possessed of objective existence; we believe it to be a particular mode of naming our sensations, or our expectations of sensation, when looked at in their relation to an external object which excites them." Further on, in developing the doctrine that the things dealt with in the syllogism are the feelings excited in us by external objects, and that the syllogism does not recognize the external objects themselves, he says that the axiom in question "might be thus worded: Two *types of sensation* each of which coexists with a third type, coexist with one another."

I am sorry to say that on this general question I diverge from Mr. Mill in a way which seems to render impossible any agreement on the special question. For the things named in the premisses and conclusion of a syllogism, I conceive to be those objective existences which are the correlatives of my subjective states. To take again Mr. Mill's instance:—The "men" spoken of in the major premiss, I hold to be so many separate objective entities, and not so many recurrences of an idea in me. The stoppage of breathing in each of these men (which is the sensible phenomenon implied by the abstract word "mortal") I regard as a change that occurs separately in each man—there are as many distinct cessations of breathing as there are distinct men. Socrates I understand to be another independent entity, like the entities classed as men. And the cessation of his breathing I consider as another change, distinct numerically, but like in nature, to the changes these other men have one by one exhibited. To make as clear as possible the interpretation I put on the terms used in syllogism, and at the same

fire, it is a necessary conclusion that it has traversed the intervening space: I am unable to conceive that it has reached its present position, without having passed through positions intermediate between that and its past position. Further, it is a necessary conclusion that some agency (very probably, though not certainly, human) has produced this change of place: it is inconceivable that there should be this effect without a cause. Here we have nothing to do with the analyses of these inferences further than to observe that, like the previous ones, they are reached by intuitions of the equality of relations. The relation between this effect as a consequent and some force as an antecedent, is conceived as one with an infinity of such relations; differing in detail, but alike in presenting uniformity of succession. And similarly with the relation between changed position and transit through space.

time to show the double duality of its composition, let me take a case in which the matter is not complicated by plurality of the major premiss Suppose that I am a naturalist to whom there is sent (say from the still unexplored interior of New Guinea) a mammal of a kind never before seen; and that, on dissecting it, I discover eight cervical vertebræ, instead of the seven by which *Mammalia* are almost universally characterized. Suppose that there is afterwards sent to me another mammal like the first in external size, form, structure, colours, etc.; and that I proceed to dissect this with the expectation of finding in it the anomalous eighth cervical vertebra. What are the terms with which I am dealing; and what is the course of my thought? I consider that my reasoning refers to two individually distinct objects beyond my consciousness, having the two individually-distinct attributes specially named. And considering this, I cannot reduce the elements of my reasoning to less than four—(1) the individual mammal I first examined; (2) the extra cervical vertebra in which it differed from nearly all other mammals; (3) the second individual mammal having special traits which make it *like* the first; (4) the *like* extra cervical vertebra which I expect to find. Now, though here the inferred relation is based on a single previous experience of a like relation (and the inference would be hazardous were it not for the wide induction that these structural correlations are usually constant in the same species), yet it is clear the course of the thought does not differ from its course when the major premiss is plural; and it is further clear that though plurality of the major premiss may be supposed to make the terms more than four, it cannot make them less than four.

CHAPTER VII.

IMPERFECT QUALITATIVE REASONING.

§ 296. While the conclusions of perfect qualitative reasoning are of such kinds that their negations cannot be conceived, those of imperfect qualitative reasoning can have their negations conceived with greater or less difficulty. The approximation of the two is, however, so close, that some members of the second class may readily be mistaken for members of the first. Thus the relation between visible and tangible attributes is such, that on receiving the ocular impressions representing an adjacent object, we cannot help concluding that there exists an adjacent object which, on putting our hands to it, will give them sensations of resistance; and by those whose experiences are very scanty, no other conclusion is conceivable. But our familiarity with looking-glasses and with optical illusions, renders it just possible for us to imagine that where there is an appearance there may be no answering solid substance. Judging from the unhesitating confidence with which, from moment to moment, cognitions of this order are accepted as guides, we might suppose them to be no less certain than those lately exemplified, in which from the invariable coexistence of tangibility with limiting surfaces we infer that an object of which we perceive one side must have another side; but we see that the two classes differ when rigorously analyzed. So, again, with cases like that incidentally cited at the close of the last chapter, in which the mortality of a par-

ticular individual is inferred from the mortality of mankind in general. Next to impossible as it seems for any one to *believe* of himself, or of another, that he will not die; yet avoidance of death is not only conceivable, but history shows us that in times past it was even believable.

§ 297. Imperfect qualitative reasoning is distinguished from perfect qualitative reasoning by the relative indefiniteness of its intuitions. Beginning with those grades in which the negation of the inference can be conceived only by the greatest effort; descending through those in which it can be conceived with less and less effort; and ending with those in which it presents itself to the mind almost as readily as the affirmation; it is throughout discriminated from perfect qualitative reasoning, and from quantitative reasoning, by the peculiarity that the compared relations are no longer to be considered as *equal* or *unequal*, but as *like* or *unlike*.

That complete indistinguishableness which characterizes the compared relations of definite necessary reasoning, is found only among the simple phenomena of number, space, time, force—is not predicable of the relations subsisting among those comparatively complex phenomena whose dependencies cannot be known, or are not yet known, as necessary. The knowledge that the ratio A : B is equal to the ratio $\frac{A}{2} : \frac{B}{2}$, is an exact intuition. The contrast in magnitude between A and B is perceived to be indistinguishable from that between half A and half B. The relations not being severally made up of many component relations, the comparison between them gives a result which is simple and precise. But when, from the general truth that motion is a constant antecedent of sound, we infer, on hearing a sound, that something has moved; or when, from human mortality at large, we infer the mortality of a par-

ticular individual; the compared relations cannot be called *equal,* but can only be called *like.* Let us observe the wherefore of this. The known relation between sound and motion as its antecedent, is not thought of as one definite relation; but as an average of many definite relations varying in the amounts, qualities, and intervals, of their antecedents and consequents. Hence the particular relation between a sound heard and a motion inferred, cannot be held *equal* to the general one; because this lacks the definiteness implied by such a predication. Even when from the nature of the sound the character of the antecedent motion is known—when from a loud crash it is concluded that a heavy body has fallen; there is still only *likeness* in the compared relations, though it is a likeness that approaches nearer to equality. For though the repeatedly-experienced relation between a loud crash and the fall of a heavy body, is far more specific than is the general relation between sound and motion; yet it is not so specific that either the size or nature of the body can be known with any precision; as it could be were the compared relations *equal* in the true sense of the word. Similarly in the second case. Though the relation between life and death is such that we can with certainty say of any individual that he will die; yet we cannot with certainty say either the time or the manner. He may die tomorrow by accident; or next year by disease; or fifty years hence of old age. While the generalization from which our conclusion is deduced, is specific in the respect that the phenomena of life are invariably followed by those of death; yet the infinity of cases included in the generalization differ more or less in every other respect. The particular relation which the conclusion recognizes, exactly parallels no particular relation before known, and has only one peculiarity in common with all the relations with which it is grouped; and therefore *likeness* only can be asserted of it and not equality. Did we regard the relation between life and

death in the abstract as purely one of succession—could we exclude all consciousness of the interval, so as to recognize no difference between the death of an infant and that of a centenarian—we might with propriety consider all cases of the relation as equal; but our inability to do this necessitates the use of the more general word.

Indeed, it needs but to observe the contrasted applications we commonly make of these words, to see the validity of the distinction. The things we habitually call equal, are either simple sensations or simple relations. We talk of *equal* lengths, breadths, and thicknesses; *equal* weights and forces; *equal* temperatures and degrees of light; *equal* times and velocities. When speaking accurately we do not, in respect to any of these, use the word *like;* unless in the qualified form "*exactly alike,*" which is synonymous with *equal.* Nor, when the compared magnitudes of these kinds are almost *equal,* do we allow ourselves to call them *like,* in virtue of their near approximation. Wherever the terms of the comparison, being both elementary, have only one aspect under which they can be regarded, and can be specifically posited either as distinguishable or indistinguishable, we call them either *unequal* or *equal.* But when we pass to complex things, exhibiting at once the attributes, size, form, colour, weight, texture, hardness—things which, if equal in some particulars, are rarely equal in all, and therefore rarely indistinguishable; then we use the term *like* to express, partly the approximate equality of the several attributes separately considered, and partly the grouping of them after a parallel manner in time and space. Similarly with the relations involved in reasoning. If simple, they are recognized as *equal* or *unequal;* if complex, as *like* or *unlike.*

§ 298. This premised, it will at once be seen that those cases of imperfect qualitative reasoning commonly given in Treatises on Logic, as illustrating the process of thought

said to be expressed by the syllogism, severally exhibit intuitions of the likeness or unlikeness of relations. When, to quote a familiar case, it is said—"All horned animals are ruminants; this is a horned animal; therefore this animal is a ruminant;" the mental act indicated is a cognition of the fact that the relation between particular attributes in this animal, is like the relation between homologous attributes in certain other animals. It may be symbolized thus :—

(The attributes constituting a horned animal)	A		a	(The attributes constituting this a horned animal)
(Coexist with)	:	is like	:	(Coexist with)
(The attributes constituting a ruminant animal.)	B		b	(The attributes constituting this a ruminant animal.)

That this formula—the relation between A and *B* is like the relation between a and *b*—represents the intuition, will, from our present stand-point, be obvious. Only in virtue of the perceived *likeness* between A and a—the group of attributes involved in the conception of a horned animal, and the group of attributes presented by this particular animal—can any such inference be valid, or even be suggested. Further, the attributes implied by the term "ruminant," can be known only as previously observed or described; and the predication of these as possessed by the animal under remark, is the predication of attributes *like* certain before-known attributes. Once more, there is no assignable reason why, in this particular case, a relation of coexistence should be thought of between these attributes and those signified by the words "horned animal," unless as being *like* certain relations of coexistence previously known; and whether the thinking of this relation can be otherwise accounted for or not, it is clear that the predication cannot otherwise have any probability, much less certainty. To state the case with greater precision — Observe, first, that as the unseen attribute predicated cannot, on the one hand, be supposed

to enter the mind save in some relation to its subject; and that as, on the other hand, the relation cannot be thought of without the subject and the predicated attribute being involved as its terms; it follows that the intuition which the inference expresses, must be one in which subject, predicate, and the relation between them, are jointly represented. Observe, next, that while subject and predicate are separately-conceivable things, the relation between them cannot be conceived without involving them both; whence it follows that only by thinking of the relation can the elements of the intuition be combined in the requisite manner. Observe, lastly, under what form this relation must be thought. Since the subject is recognized as *like* certain others previously known, with which it is classed; and since the attribute predicated is conceived as *like* an attribute possessed by these previously-known members of the class; and since the relation between the subject and the predicated attribute is proved, by the truth of the predication, to be *like* the relation subsisting in these previously-known members of the class; it must be by recognizing the relation as *like* certain previously-known relations, that the conclusion is reached.

On contemplating the parallelism between this species of reasoning and that species of mathematical reasoning which is confessedly carried on by comparison of relations, we shall find this interpretation confirmed. The unknown fact predicated in a syllogism, is perfectly analogous to the unknown fourth term in a proportion. Let us take cases.

SYLLOGISM.	A (the fermentation of wort)	:	*B* (is simultaneous with)	(the evolution of carbonic acid)	is like	a (the fermentation in this vat of wort)	:	*b*	( )
PROPORTION.	A (the walking a mile)	:	*B* (is simultaneous with)	(the lapse of fifteen minutes)	equals	a (the walking this quarter of a mile)	:	*o*	( )

In each of these acts of ratiocination (mark the word) the

fourth term *b*, represents the thing inferred; and seeing, not only that it is similarly related to its data in the two cases, but that the data stand in like relations to one another, the essential likeness of the mental processes is manifest. No doubt they have their differences; but an examination of these serves but to show the fundamental agreement. Let us make a close comparison. The fact that the predication in the first is qualitative while in the second it is quantitative, though true in the main, and important as a general distinction, is not true in an absolute sense. When strictly analyzed, both prove to be qualitative and both in some degree quantitative. A glance at the forms in which the two inferences present themselves to the mind, will render this obvious. The first (that carbonic acid is being evolved) is, in the main, and as verbally expressed, merely qualitative—refers to the *nature* of a certain process and a certain product; and the second (that a specified portion of time will elapse), though distinguishable as quantitative, is by implication qualitative also; since not only is a magnitude predicated, but a magnitude of *time:* the thing inferred is defined alike in *nature* and *amount.* As thus regarded, then, the first inference is qualitative, and the second both qualitative and quantitative. If we examine the two inferences still more closely, and, neglecting the words in which they are expressed, consider the mental states those words describe, we shall see a still nearer approach. For though the first inference as verbally rendered (carbonic acid is being evolved) is in no respect quantitative; yet the idea so rendered is joined with an idea of quantity, more or less definite. The experiences by which it is known that fermenting wort gives out carbonic acid, are accompanied by experiences of the quantity given out; and vague as these may be, they are yet such that when the brewer says a certain vat of fermenting wort contains carbonic acid, he thinks of the carbonic acid as more, certainly, than a cubic foot; less, certainly, than the total capacity of the vat: the quantity is thought of as in some

ratio to the quantity of wort. Again, in the second case, though the inference as verbally rendered (the lapse of three minutes and three-quarters) is specifically quantitative; yet the idea so rendered, *if examined in its primitive form*, is not specifically quantitative. A man who has walked a mile in fifteen minutes, and, observing that he has a quarter of a mile still to go, infers the time it will take to reach his destination, does not primarily infer *three minutes and three-quarters:* he primarily infers *a short time*—a time indefinitely conceived as certainly less than ten minutes, and certainly more than one. By a process based on the perceived equality of the relations between time and distance, he can afterwards calculate the interval exactly. But, as it will not be contended that he can know the exact interval without calculation; and as it must be admitted that before making the calculation he has an approximate notion of the interval; it must be confessed that though his ultimate inference is definitely quantitative, his original one is but indefinitely quantitative. The two inferences, then, as at first formed, are alike in being qualitative and indefinitely quantitative; and they differ simply in this—that while in the one, the quantitative element is neglected as incapable of development, in the other, it is developed into a specific form. Seeing, then, that the parallelism between them is so close, it cannot be questioned that as the last is reached by an intuition of the equality of two relations, so the first is reached by an intuition of the likeness of two relations.*

* The foregoing analysis, in which it is incidentally pointed out that every act of specifically-quantitative reasoning is preceded by a provisional act of qualitative reasoning (which is only potentially quantitative), suggests an interesting analogy between these particular processes of reasoning, and the general evolution of reasoning. For not only is it true that, in the course of civilization, qualitative reasoning precedes quantitative reasoning; not only is it true that, in the growth of the individual mind, the progress must be through the qualitative to the quantitative; but it is also true, as we now find, that every act of quantitative reasoning is qualitative in its initial stage.

It is unnecessary here to illustrate or analyze that kind of so-called syllogistic reasoning by which negative inferences are reached. It differs from the foregoing kind simply in this; that the fact recognized is not the likeness, but the unlikeness, of two compared relations. Nor is it requisite to say anything about the different forms and modes of the syllogism; which obviously seek to express, partly the order in which the terms of the two relations are contemplated, and partly the extent to which the relations hold, as being either universal or partial. A psychological analysis like the present, properly includes nothing beyond an explanation of the general nature of the mental process involved.

Neither will it be needful to treat of that compound qualitative reasoning exemplified in all cases where an inference is reached, not by a single intuition of the likeness or unlikeness of relations, but by a connected series of such intuitions. Analogous as such cases are to those of compound quantitative reasoning examined in previous chapters, and consisting, like them, of successive inferences that are sometimes severally perfect and sometimes only part of them perfect; it will suffice to refer the reader to §§ 282, 284, for the general type, and to his own imagination for instances.

§ 299. But before leaving that division of imperfect qualitative reasoning which proceeds from generals to particulars, it is desirable to notice the fact that, by an easy transition, the so-called syllogistic reasoning passes into what is commonly known as reasoning by analogy. We shall find that this last differs from the first, simply in the much smaller degree of likeness which the terms of the inferred relation bear to those of the known relations it is supposed to parallel.

In the syllogism as ordinarily exemplified, the things classed together as the subject of the major premiss have usually a great number of attributes in common, besides the

one particularly predicated of them. The individual or sub-class which the minor premiss names, has also a great number of attributes in common with this class named in the major premiss. And it is only because of this extensive community of attributes that the inferred attribute is asserted. Thus, when it is argued—"All men are mortal; this is a man; therefore this man is mortal;" it is clear that the individual indicated, and all members of the class to which he is referred, exhibit a high degree of similarity. Though they differ in colour, stature, bulk, in minor peculiarities of form, and in their mental manifestations; yet they are alike in so many leading characters that there is no hesitation in grouping them together. When, again, it is argued—"All horned animals are ruminants; therefore, this horned animal is a ruminant;" we see that though the sub-classes—such as oxen, deer, and goats—which are included in the class horned animals, differ considerably in certain respects; and though the particular horned animal in question, say an ibex, differs very obviously from all of them; yet they have various traits in common besides having horns. If, taking a wider case, we say that since all mammals are warm-blooded this mammal is warm-blooded; it will be remarked that the class—including whales, mice, tigers, men, rabbits, elephants—is far more heterogeneous. If, once more, we infer the cold-bloodedness of a fly from the general fact that all annulose animals are cold-blooded; the class, including worms, crabs, butterflies, spiders, mites, centipedes, beetles, is more heterogeneous still. And the heterogeneity approaches its extreme, when we draw an inference from the proposition that all animals contain nitrogen. But now let it be noticed that in these latter cases, in which the objects grouped together have so many differences, the probability of the conclusion come to, depends on the previous establishment of the asserted relation throughout a great variety of the sub-classes included in the general class. Had only oxen and

goats been found to ruminate, the presumption that any other species of horned animal ruminated would be but weak The warm-bloodedness of a new kind of mammal would be but doubtfully inferable if only a dozen other kinds were known to be warm-blooded: no matter how many of each kind had been tested. In each of these cases the reasoning, while yet the general fact was unestablished, would be merely analogical; and would be so recognized. Take a parallel instance. The elephant differs from most mammals in having the teats placed between the fore limbs, and also in the structure of the hind limbs, which have their bones so proportioned that where there is usually a joint bending backwards, there is a joint bending forwards. In both these peculiarities, however, the elephant is like man and the primates generally; while at the same time it approaches them in sagacity more nearly than any other creature does. If, now, another species organized after the same fashion were discovered, and much intelligence were to be expected from it, the expectation would imply what we call an inference from analogy; and vague as this analogy would be, it would not be more vague than that which led to the expectation that other horned animals ruminated, while yet rumination had been observed only in oxen, goats, and deer. Moreover, just as when to oxen, goats, and deer, were added many other genera in which the like relation subsisted, the basis of deduction was so far enlarged as to give the inferred rumination of a new horned animal something more than analogical probability; so, were the relation between special intelligence and physical characteristics above described, found in a hundred kinds of mammalia, the inference that a mammal possessing these physical characteristics was intelligent, would be an ordinary deduction; and might serve logicians as an example of syllogizing, equally well with the preceding one. Thus, premising that in the syllogism the word "all" means—all that are known

(and it can never mean more), it is clear that ordinary syllogistic deductions differ from analogical ones, simply in degree. If the subjects of the so-called major and minor premisses are considerably unlike, the conclusion that the relation observed in the first will be found in the last, is based on analogy; which is weak in proportion as the unlikeness is great. But if, everything else remaining the same, the assemblage named in the major premiss has added to it species after species, each of which, though considerably unlike the rest, has a certain group of attributes in common with them, and with the subject of the minor premiss; then, in proportion as the number of different species becomes great, does the conclusion that a relation subsisting in every one of them subsists in the subject of the minor premiss, approach to a deduction.

In an order of more remote analogical reasoning, we find much unlikeness between the predicates, as well as between the subjects. To formulate an example:—

(The growth of an individual organism)	A	is like	𝔄	(The growth of a society)
(Is simultaneous with)	:		:	(Is simultaneous with)
(The subdivision of functions among its parts.)	l		𝔩	(The division of labour among its members.)

In this case, the likeness in virtue of which a society is referred to the class, organisms, is very distant; and there is not much apparent similarity between the progress of organic economy and that of industrial economy. Hence the inference might be considered but little more than an idle fancy, were it not inductively confirmed by past and present history.

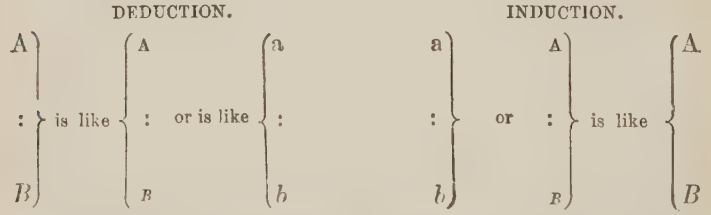
And now, let us not overlook the bearing of these cases on the general argument. Note, first, that analogical reasoning is the antipodes of demonstrative reasoning; both as being uncertain and as having widely dissimilar things

for the terms of its relations. While in mathematical and other necessary inferences, the things dealt with have few attributes, and the relations among them are capable of accurate determination as *equal*, or exactly alike; and while in imperfect deductive reasoning the things dealt with have many attributes which, though somewhat different, have so much in common that most of their relations may properly be called *like;* in analogical reasoning the things dealt with are, in many respects, conspicuously *unlike;* and the presumption that they are like in respect of some particular relation becomes correspondingly small. Secondly, let it be remarked that while ordinary class-reasoning is, under one aspect, parallel to that species of mathematical reasoning which recognizes the equality between one relation of 2 : 3, and all other relations of 2 : 3; reasoning by analogy is, under the same aspect, parallel to that species of mathematical reasoning which recognizes the equality between the relation 2 : 3 and the relation 6 : 9—an equality called a numerical analogy. In the third place observe that as, in the case of analogical reasoning, the likeness of the relations is the thing contemplated (since it would never occur to any one to consider society as an organism, until he had perceived that certain relations between the functions of its parts are like the relations between the functions of the parts constituting an animal); and as perfect quantitative reasoning confessedly proceeds by intuitions of the equality or exact likeness of relations; we have yet further grounds for holding that all orders of reasoning which lie between these extremes, and which insensibly merge into both, are carried on by a similar mental process.

§ 300. From that kind of imperfect qualitative reasoning which proceeds from generals to particulars, we now pass to that kind which proceeds from particulars to generals: in other words—to inductive reasoning. From our present

stand-point the fundamental differences of these, as well as their fundamental similarities, become clearly apparent. Both kinds are seen to be carried on by comparison of relations; and the contrast between them is seen to consist solely in the numerical preponderance of the premised relations in the one case, and of the inferred relations in the other.

If the known relations grouped together as of the same kind, outnumber the unknown relations conceived to be like them, the reasoning is deductive; if the reverse, it is inductive. In the accompanying formula, arranged to exhibit this contrast, the group of attributes in virtue of which the things are named, are symbolized by A, or A, or a, according as they are thought of as possessed by all, or some, or one; and for the particular attribute or set of attributes predicated as accompanying this group, the letter *B*, or B, or *b*, is used, according as the subject of it is all, some, or one.



Class. Sub-class. Individual. *Individual. Sub-class. Class.*

The first form might be filled up thus:—Like the general observed relation between living bodies and fertilized germs, is the relation between these infusoria and fertilized germs, or is the relation between this entozoon and a fertilized germ. The second form might be filled up thus:—Like the observed relation between the development of this plant and its progress from homogeneity to heterogeneity of structure, or like the observed relation between the development of these animals and their progress from homogeneity to heterogeneity of structure, is the general

relation in all organisms between development and progress from homogeneity to heterogeneity of structure.

Some possible criticisms on this exposition must be noticed. In the formula of the inductive process, as well as in the illustration, I have introduced the generalization of a whole class of cases from the observation of a single case—a generalization which seems illegitimate. To this objection there are two replies. The first is that our immediate subject is not logic, but the nature of the reasoning process, whether carried on conclusively or otherwise. If, as will not be denied, many people found general conclusions on solitary instances—if, as must be admitted, the mental process by which they advance from data to inference is the same in nature where the data are insufficient as where they are sufficient; then, an account of this mental process may properly include examples of this kind. The second reply is, that throughout a wide range of cases such inductions are legitimate. When it has been demonstrated of a particular equilateral triangle that it is equiangular, it is forthwith inferred that all equilateral triangles are equiangular; and countless general truths in mathematics are reached after this fashion. Hence, a formula for induction not only *may* but *must* include the inference from the singular to the universal. A further criticism which will perhaps be passed is, that in quoting as an instance of deduction, the argument that infusoria have fertilized germs because living bodies in general have them, a questionable instance has been given; as is proved by the fact that there are many by whom this conclusion is rejected. My answer is again twofold. Most of the deductions by which every-day life is guided are of this imperfect order; and hence, whether valid or invalid, they cannot be excluded from an account of the deductive process. Further, I have chosen a case in which the conclusion is open to possible doubt, for the purpose of implying that in all cases of contingent reasoning, the unknown relation predicated can

never possess anything more than a high degree of probability—a degree proportionate to the frequency and uniformity of the parallel experiences.

This doctrine is, I am aware, quite at variance with that held by some logicians. Irrespective of the distinction between necessary and contingent matter, Sir William Hamilton contends not simply that there are both Deductions and Inductions in which the conclusion is absolutely necessitated by the premisses, but that all other Deductions and Inductions are extra-logical. To discuss this question fully, would carry us too much away from our subject. Such brief criticisms only can be set down, as seem requisite for defence of the opposite doctrine. Among general objections to Sir William Hamilton's argument (see *Discussions*, &c., pp. 156 to 166), may be noted the fact that he uses the word *same* in place of the word *like*, after a fashion equally ambiguous with that pointed out in the last chapter. Moreover, he employs the words *whole* and *parts* (to stand for a logical class and its constituent individuals) in a mode implying that in thinking of a whole we definitely think of *all* the contained parts—an assumption totally at variance with fact. No one in arguing that because all men are mortal, this man is mortal, conceives the *whole* "all men," in anything like a complete circumscribed form. His conception answers neither to the objective whole (all the men who exist and have existed), which infinitely exceeds his power of knowing; nor to the subjective whole (all the men he has seen or heard of), which it is impossible for him to remember. Yet unless logical wholes are conceived in a specific manner, Sir William Hamilton's doctrine cannot stand; for the perfect Induction and perfect Deduction which alone he allows to be the subject-matter of Logic, imply wholes that are known by "enumeration (actual or presumed) of *all* the parts." Again, let us consider the results following from this distinction which Sir William Hamilton

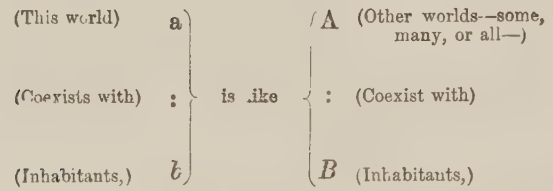
draws between the logical and the extra-logical. Other logicians, he says, have divided Induction "into *perfect* and *imperfect*, according as the *whole* concluded, was inferred from *all* or from *some* only of its constituent parts." This he considers to involve "a twofold absurdity;" and asserts that that only is logical induction which infers the *whole* from the enumerated *all*. If this be so, there arises the question—What is the nature of that so-called *imperfect* induction which infers wholes from *some* only of the constituent parts? Sir William Hamilton says it is extra-logical. Still it is a species of reasoning—a species by which the immense majority of our conclusions are drawn; and *rightly* drawn. Hence, then, there are two kinds of Induction (as well as of Deduction), one of which is recognized by the science of Logic while the other is ignored by it. This somewhat startling implication will lead us to a very astonishing conclusion if we ask the essential nature of the difference, which, according to this hypothesis, exists between the logical and the extra-logical. When, proceeding by the so-called imperfect induction, I infer from the many instances in which I have seen butterflies developed from caterpillars, that all butterflies are developed from caterpillars; it is clear that the inference contains multitudinous facts of which I have never been cognizant: from a few known phenomena, I conclude innumerable unknown phenomena. On the other hand, suppose I proceed by the so-called perfect induction, which does not allow me to predicate of the whole anything that I have not previously observed in every one of the parts, and which, therefore, does not permit, as logical, the conclusion that all butterflies are developed from caterpillars; what will then be the course of my reasoning? It must be that as each of the butterflies (which I have observed) was thus developed, the whole of the butterflies (which I have observed) were thus developed; and here it is clear that the so-called conclusion contains nothing but

what is previously asserted in the premiss—is simply a *colligation* under the word *whole*, of the separate facts indicated by the word *each*—predicates nothing before unknown. See then the contrast between these two kinds of mental procedure. In the one, from something known, something unknown is predicated; in the other, from something known, nothing unknown is predicated. Yet both are called reasoning—the last logical; the first extra-logical. This seems to me an impossible classification. The two things stand in irreconcilable opposition. Agreeing, as I do, with Sir William Hamilton in considering it absurd to include in logic both perfect and imperfect induction, I do so on exactly opposite grounds; for this which he calls perfect induction, I conceive to be not reasoning at all, but simply a roundabout mode of defining words. All reasoning, Inductive or Deductive, is a reaching of the unknown through the known; and where nothing unknown is reached there is no reasoning. The whole process of stating premisses and drawing conclusion, is a wanton superfluity if the fact which the conclusion asserts is already given in experience. Suppose I have noticed that A, B, C, D, E, F, &c. severally possess a given attribute; do I then, by this so-called Induction, group them together as all possessing such attribute, that I may be afterwards able by the so-called Deduction to infer that E or F possesses it? Certainly not. By the hypothesis, I have already noticed that E and F possess it; and knowing this by a past perception, have no need to reach it by inference. Yet this ascent from the known constituent parts to the constituted whole, is all that Sir William Hamilton recognizes as logical Induction; while the descent from such constituted whole to any, some, or one, of such constituent parts, is all that he recognizes as logical Deduction. And thus, in the endeavour to establish necessary logical forms, he exhibits forms which the intellect never employs; nor ever can, with any propriety, employ.

Returning from this digression, which certain anticipated objections made needful, we have to observe that the inductive process above formulated, applies alike to the establishment of the simplest relations between single properties, and the most complex relations between groups of properties and between groups of objects. As is now usually admitted, the process by which a child reaches the generalization that all surfaces returning bright reflections are smooth to the touch, is fundamentally like that by which the physiologist reaches the generalization that, other things equal, the heat of an animal is proportionate to the activity of its respiration. Between those earliest organically-registered inductions on which are based the almost automatic deductions that guide our movements from moment to moment, and those latest ones which only the highly-cultured man of science can draw, may be placed a series connecting them by scarcely sensible gradations. The members of it differ in several ways—partly in the comparative infrequency with which the relations are experienced; partly in the increasing complexity of the terms between which the relations subsist; and partly in the increasing complexity of the relations themselves. Throughout the whole series, however, the essential act of thought is a cognition of the likeness between certain before-known relations and certain relations not yet known by perception, but represented by imagination. And the trustworthiness of this cognition varies sometimes according to the numerical ratio between the observed and unobserved relations, sometimes according to the simplicity of their nature, sometimes according to their analogy to established relations, sometimes according to all these.

Any detailed consideration of the conditions under which the inductive inference is valid, would here be out of place. We have now only to examine the mental act by which such inference is reached; and this is the same in *form* whether the data are adequate or not. The only further remark called for is that (excluding the mathematical inductions

before named) when the observed relations are very few in number, or when the terms between which they subsist differ much from the terms of the relations classed with them, or both, we have what is known as an hypothesis. Thus, to quote an example from a recent controversy, if we argue that—



it is clear that, though inductive reasoning is simulated in form, the presumption that the relations are like is not strong; and nothing beyond probability (which some think but small) can be claimed for the inference. Were the likeness between the terms of the known and unknown relations greater—were all other worlds physically like this world in most particulars; the hypothesis would have increased probability. And then if, of worlds thus physically similar, we ascertained that hundreds, thousands, tens of thousands, were inhabited; the inference that all were inhabited would become an ordinary induction. Whence it becomes manifest not only that, as we all know, hypothesis must precede induction, but further, that an hypothesis *is* an induction in the incipient stage: capable of being developed into one if there are facts for it to assimilate; likely to dwindle away if there are none.

§ 301. To the foregoing two orders of imperfect qualitative reasoning—that which proceeds from generals to particulars, and that which proceeds from particulars to generals—has to be added a third order, which Mr. Mill names reasoning from particulars to particulars. This, as he points out, is the primitive kind of reasoning; habitually exemplified in children and in the higher animals. And, as he also conclu-

sively shows, it is the kind of reasoning by which most of our daily acts are guided.

The simplest form of it is that in which, from a single instance of an experienced relation, another like relation is inferred. This is the form to which both Induction and Deduction may be degraded by continually diminishing the number of their observed or predicated facts; and it is thus the form which lies midway between them, as the common root whence they diverge. In all the examples of reasoning hitherto given, either the known relations serving for data were plural, or the unknown relations predicated were plural, or both were plural. But in this aboriginal reasoning, both the premised and the inferred relations are singular. The mental act is an intuition of the likeness (or unlikeness) of one relation to one other relation. The burnt child who, having once experienced the connexion between the visual impression of fire and the painful sensation which fire produces in the skin, shrinks on again having his hand put near the fire, is mentally possessed by a represented relation between fire and burning, similar to the before-presented relation. In this simplest and most imperfect ratiocination, we may clearly see that the thing remembered, which stands for premiss, is a relation; that the thing conceived, which stands for inference, is a relation; that the presentation of one term of this inferred relation (the fire) is followed by the representation of its other term (burning); that the relation thus conceived, is so conceived solely because there is a past experience of the relation between fire and burning; and that hence, by the very conditions of its origin, the new relation is conceived as *like* the previously-known one.

The verification thus furnished of the general view set forth is complete. For it is manifest that while, by the multiplication of experiences, the known and unknown relations, instead of being respectively one and one, become many and many, and so originate Deduction and Induction, the act of thought by which the inference is reached, remains throughout fundamentally similar.

CHAPTER VIII.

REASONING IN GENERAL.

§ 302. Before summing up the evidence, and presenting under its most general form the doctrine which the foregoing chapters present in detail, a question of much interest must be discussed. We have to consider the current doctrines respecting logical forms; to see whether the syllogism has any uses, and, if so, what they are. Further we have to inquire how there has arisen the absolute opposition between those who affirm that the syllogism presents analytically the mode in which all men reason, and those who affirm that the syllogism is valueless. In the words of Mr. Mill, one set of writers "represent the syllogism as the correct analysis of what the mind actually performs in discovering and proving the larger half of the truths, whether of science or of daily life, which we believe; while those who have avoided this inconsistency, and fol lowed out the general theorem respecting the logical value of the syllogism to its legitimate corollary, have been led to impute uselessness and frivolity to the syllogistic theory itself, on the ground of the *petitio principii* which they allege to be inherent in every syllogism."

With the remark that what follows must not be taken as an admission that the doctrine of the syllogism is coextensive with logical doctrine in general, which is much the wider, I proceed to point out that there is a possible

reconciliation between these antagonists. But it is a reconciliation which, strangely enough, is to be effected only by denying the tacit assumption of both, that the syllogism refers to the dependencies of our *thoughts*, and by affirming, contrariwise, that it refers to the dependencies of *things*. Those who do not avowedly recognize the antithesis of subject and object, must, I think, end by accepting one of these opposite estimates of the syllogism and rejecting the other; but for those who acknowledge that subject and object are separate realities, there is a way of bringing these views into harmony, by showing how each is right in one sense and wrong in another. A distinction exists which, in consequence of its highly abstract nature, is not easily perceived, between the science of Logic and an account of the process of Reasoning—a distinction which, once seized, disposes completely of the difficulty. The distinction is, in brief, this, that Logic formulates the most general laws of correlation among existences considered as objective; while an account of the process of Reasoning, formulates the most general laws of correlation among the ideas corresponding to these existences. The one contemplates in its propositions, certain connexions predicated, which are necessarily involved with certain other connexions given: regarding all these connexions as existing in the *non-ego*—not, it may be, under the form in which we know them, but in some form. The other contemplates the process in the *ego* by which these necessities of connexion come to be recognized.

Why this distinction has eluded observation, it is not difficult to see. Logic on the one hand, and the theory of Reasoning on the other, deal with relations from which all concrete terms are, as far as possible, expelled. They are severally obliged to use some terms (which, however, are by preference symbolic, so that they may express indifferently any kind of existence, attribute, action, or even relation); otherwise the relations dealt with cannot be expressed, or

distinguished from one another. But they intentionally ignore the natures of the terms, and occupy themselves with the most general dependencies of these most abstract relations. The result is that, in the absence of terms definitely specified as belonging either to the outer world or to the inner world, the two sets of relations, belonging the one to the outer world and the other to the inner world, become indistinguishable. Hence there arises this confusion between Logic, which is as much a division of the science of objective existence as Mathematics, and the theory of Reasoning, which is a division of subjective science.

To show that the affirmations of Logic refer to the connexions among things considered as existing apart from our consciousness, and not to the correlative connexions among our correlative states of consciousness, we need but to take the case of logical propositions as numerically quantified, in the system of Prof. de Morgan. I quote Mr. Mill's condensed statement of the doctrine; for Prof. de Morgan's own statements are so encumbered with details and symbols, that I cannot find in his work one that is at once brief and adequate.

"From the premises Most B's are C's, most B's are A's, it may be concluded with certainty that some A's are C's, since two portions of the class B, each of them comprising more than a half, must necessarily in part consist of the same individuals. Following out this line of thought, it is equally evident that if we knew exactly what proportion the 'most' in each of the premises bear to the entire class B, we could increase in corresponding degree the definiteness of the conclusion. Thus if 60 per cent. of B are included in C, and 70 per cent. in A, 30 per cent. at least must be common to both; in other words, the number of A's which are B's, and of C's which are A's, must be at least equal to 30 per cent. of the class B."

If we make the syllogism not only numerically definite, but, in place of symbolical terms, put terms that express

realities, the objective character of the relations we are considering becomes still clearer. Suppose, in the case above-named, the class B stands for the total number of animals, partly oxen, partly sheep, on a farm. Suppose the class C comprehends all the sheep; while the class A comprehends all the diseased animals. Then if most of the animals are sheep, and if most of the animals are diseased, it is certain that some of the diseased are sheep: the oxen being the numerically-smaller class, cannot by themselves, even if they are all diseased, fulfil the statement that most of the animals are diseased. But now, apart from words and symbols, what is the fact we mean to assert? We mean to assert that if we separated the diseased animals from the healthy, we could not form a group of the entities classed as diseased animals, which should be the larger half of the entire assemblage, without taking into it some of the entities classed as sheep: *we are unquestionably contemplating necessary objective relations.* With equal clearness is this truth implied by the performance of the syllogistic process mathematically, after the methods discovered by Prof. Boole. To quote the words of Prof. Jevons—"Boole showed incontestably that it was possible, by the aid of a system of mathematical signs, to deduce the conclusions of all these ancient modes of reasoning, and an indefinite number of other conclusions. Any conclusion, in short, that it was possible to deduce from any set of premises or conditions, however numerous and complicated, could be calculated by his method." Now, since it is admitted that mathematical analysis deals with relations which are considered as objectively existing, and, in the last resort, tests its conclusions respecting the necessary inter-dependencies of these objective relations by appeal to actual perception; it must be admitted that this form of mathematical analysis to which Logic is reducible, does the same thing. But the clearest proof that relations among objective existences form the subject-matter of

Logic, is yielded by the mechanical performance of logical inference. Prof. Jevons has devised a machine of such kind that, its keys being pressed down in proper order in conformity with the premisses of the given logical proposition, the conclusion is presented by the combinations which the machine displays. Here it is undeniable that the relation disclosed is an objective one; and it is equally undeniable that the thing ascertained is, that this objective relation was necessarily involved in those other objective relations which constituted the premisses. We have nothing to do with thought at all. We have to do with inter-dependencies among outer things or agencies. The machine having been set to represent objects and attributes in certain relations, evolves certain necessarily-accompanying relations, such as would otherwise be ascertained by actual examination of the objects and attributes.

A conclusion harmonizing with this may, indeed, be reached *à priori*. If there is a division of science, properly to be called Concrete, which treats of existences considered in all their fulness as objective entities—if there is another division of science, fitly distinguishable as Abstract-Concrete, which treats separately of the various modes of force which these existences exhibit, still considering these modes of force as objective—if, of the remaining division of science, which is truly Abstract, there is a part that treats of quantitative relations considered as separate from related things, still, however, considering these quantitative relations as objective; then there must remain a further most general part of this Abstract division, which, ignoring all distinctions of being, attribute, quantity, treats of the necessary correlations common to all cases, still considering these necessary correlations as objective. There must be such a science of universal objective correlations; and that science is Logic.

The propositions of Logic, then, primarily express necessary dependencies of things, and not necessary depen-

dencies of thoughts; and in so far as they express necessary dependencies of thoughts, they do this secondarily—they do it in so far as the dependencies of thoughts have been moulded into correspondence with the dependencies of things. I say advisedly, "*in so far as*"; for there are certain absolute unlikenesses of nature between the outer dependencies and the inner dependencies, which for ever forbid anything more than a symbolic correspondence, as we shall hereafter see more clearly. The greater part of the necessary objective correlations are *statical*, while all the necessary subjective correlations are *dynamical*; and only in so far as dynamical correlations may be so arranged as to symbolize statical correlations, can the necessary dependencies of Reason be made to parallel the necessary dependencies of Logic.

I have reserved to the last, a mode of illustrating the relation of Logic to the other sciences, which will, I think, show unmistakably that it must be classed as objective. Suppose I am giving to a child a lesson in Mathematics, carried on after that concrete method which teachers, were they wise, would habitually adopt as an initiation. I take a number of its marbles—say, fifty. I show to it that four rows of four, placed side by side, will make a square containing sixteen; and I show it that out of its fifty marbles it can make three such squares, and have two marbles remaining. Again, I show it that by placing together five rows of five each, it may make a larger square, which, on counting, proves to contain twenty-five; and further, I lead it to observe that its fifty marbles will serve to make exactly two such squares. Once more, I suggest the experiment of making a line of seven marbles and placing seven such lines next to one another: the result being the discovery that out of its fifty marbles only one remains over when this square is made. Having thus introduced it by sensible experiences to the numerical truths that four fours make sixteen, and three sixteens forty-eight; that five fives make twenty-five, and that there

are two twenty-fives in fifty, and so on; and having simultaneously introduced it to certain correlative geometrical truths respecting the natures of squares, and the relations between their areas and their sides; I go on to draw its attention to some truths of another class. By long use, many of the marbles have become chipped—more than half, according to the complaint made. I have myself observed in the course of these experimental lessons, that there are more streaked marbles than plain ones. And now I point out to the child that as, out of all its marbles, the number chipped is greater than the remaining number, and that as out of all its marbles there are more streaked than plain, some of the streaked marbles must be chipped. Examination proves this to be the fact. By way of showing that this fact is a necessary one, I take other marbles, and make up a group of fifty in which, to fulfil the conditions of the case, there are twenty-six streaked and twenty-four plain, and in which all the plain ones are chipped; and then I ask the child to make out of this fifty a group of chipped marbles that is larger than the remaining group of unchipped ones. It cannot do so. Though all the plain ones are chipped, they do not amount to one-half; and it finds that a group of chipped marbles amounting to more than one-half, cannot be formed unless some of the streaked marbles are chipped. And now what is the truth here disclosed to it? Nothing else than the truth expressed in the quantified syllogism, that if most B's are C's, and most B's are A's, some A's are C's. See, then, the inevitable implication. No one questions the fact that while I was using these marbles to exemplify arithmetical truths and geometrical truths, I was contemplating, and was teaching, necessary objective correlations. Can it be that when I used these same marbles to exemplify necessities of correlation among groups and sub-groups, distinguished by certain marks, I passed from the region of objective necessities to the region of subjective necessities? No one will, I think, have the

hardihood to assert as much. There is no choice but to leave these most general laws of correlation which Logic formulates, outside along with the laws of numerical correlation and geometrical correlation; or else, bringing them into the mind as laws of thought, to bring with them these mathematical laws as laws of thought in the same sense, and, by other steps equally unavoidable, to merge all objective facts in subjective facts: thus abolishing the distinction between subject and object.

And now having recognized the truth that Logic is a science pertaining to objective existence, and that so understood it has a definite function and value; and having recognized the correlative truth that Logic cannot be a science pertaining to subjective existence—cannot be a statement of laws of thought; we shall be prepared for appreciating the several independent proofs of the implied proposition that we do not reason by syllogism. To these we will now pass.

§ 303. There appears to be among logicians a general agreement that a certain abstract truth said to be involved in every syllogism, is recognized by the mind in going through every syllogism; and that the recognition of this abstract truth under any particular embodiment, is the real ratiocinative act. Nevertheless, neither the *dictum de omni et nullo*—"that whatever can be affirmed (or denied) of a class may be affirmed (or denied) of everything included in the class;" nor the axiom which Mr. Mill evolves—"that whatever possesses any mark possesses that which it is a mark of;" nor indeed any axiom which it is possible to frame, can, I think, be rightly held capable of expressing the ratiocinative act.

Saying nothing of special objections to be urged against these or kindred propositions, they are all open to the fundamental objection that they state substantive truths perceived by reason; not the mode of rational perception. Each of them expresses a piece of knowledge; not a method of

knowing. Each of them generalizes a large class of cognitions; but does not by so doing approach any nearer to the nature of the cognitive act. Contemplate all the axioms —"Things that are equal to the same thing are equal to each other;" "Things that coexist with the same thing coexist with each other;" and so forth. Every one of them is a rational cognition; and if any logical axiom be added to the number, it also must be a rational cognition. These axioms, then, are all of one family—become known by similar intellectual acts. But if so, how can the addition of a new one to the list answer the question—What is the common nature of these intellectual acts?—what is the course of thought by which axioms become known? Axioms can belong only to the subject-matter about which we reason, and not to reason itself—imply cases in which an objective uniformity determines a subjective uniformity; and all these subjective uniformities can no more be reduced to one than the objective ones can.

The distinction drawn in the foregoing section between the science of Logic and the theory of Reasoning, at once opens a way out of this secondary perplexity. We can admit that these logical axioms express universal truths, without admitting that they are axioms tacitly asserted in drawing valid inferences. For, understanding Logic to be the most abstract of the objective sciences, made up, like other objective sciences, of truths some special and some general, we may expect to find among these certain *most* general truths. If it has for its subject-matter objective relations among terms the natures of which are ignored—if it occupies itself solely with the various necessities of correlation among these relations; it is clear that there will be some *universal* necessity of correlation—some axiom. Such an axiom is therefore to be accepted as expressing absolute dependencies in the *non-ego*, which imply answering absolute dependencies in the *ego*—not, however, absolute dependencies in the *ego* that are recognized as such in reasoning.

The utmost that any analysis of reason can effect is to disclose the *act of consciousness* through which these and all other mediately known truths are discerned; and this we have in the inward perception of likeness or unlikeness of relations. But a truth of this kind does not admit of axiomatic expression, because the universal *process* of rational intelligence cannot become solidified into any single *product* of rational intelligence.

§ 304. A true theory must be co-extensive with all the facts. Let us bring the theory of logicians to this test. We shall find that the simplest deliverances of reason as well as its most complex deliverances, have alike a form which the syllogism fails utterly to represent.

For how are we to express syllogistically the data for the conclusion that "things which are equal to the same thing are equal to one another," or for the conclusion that "if from unequals equals be taken, the remainders are more unequal"? Neither of these truths is reached by direct external perception. Nor has either of them been reached through successive experiences of past cases, in which the alleged connexion of facts existed; which it must have been if the warrant for it is of a kind to be formulated in a syllogism. Each of these truths is reached by an intuition of reason; but it is an intuition of which the theory of reason, as logicians present it, gives no account whatever. All the various simple axioms, quantitative and qualitative, treated of in the preceding chapters, are extra-syllogistic; and if so, one of two things is inevitably implied—either that there is a kind of reasoning formulated by syllogism and another kind of reasoning so entirely different that syllogism cannot formulate it, or else that syllogism does not formulate reasoning at all.

If it be urged that these axiomatic truths are truths recognized by the simplest order of reasoning, and that syllogizing represents reasoning of a developed order, the defence

serves but to bring on a still more serious attack. For the syllogism can as little express the most involved deliverances of reason as it can express its simplest deliverances. There are ratiocinative acts much more complex than those which the syllogism professes to formulate, that cannot by any manœuvre be brought within it. Of these I have given an example at the outset (§ 277). The engineer who, from the fact that a tubular bridge built by him is only just strong enough, infers that a tubular bridge similar in all respects but of double the size will not support itself; goes through a process of thought which is in a much higher degree rational, than that through which the mortality of one man is inferred from the mortality of all men. Yet it is not expressible by syllogism. No single case has occurred before in his experience on which he bases this conclusion; nor have such cases occurred in the experiences of other men. Yet by a mental act which, though complicated, is not separable into steps, he rightly draws the inference: he recognizes in a particular case the general truth that ratios which are severally equal to certain other ratios that are unequal to each other, are themselves unequal. Not indeed that he overtly proceeds upon this complex axiom. He has never been taught it; he would seek for it in vain among acknowledged axioms; and he does not become aware of it even when tacitly asserting it. Hence besides the fact that neither his experiences nor those of others have furnished a major premiss for the conclusion he draws, we have the fact that he is unconscious of the class of inferences in which his particular inference is included. Nevertheless, having the data before him, he reaches through an intuition that is undeniably rational, and rational in an unusually high degree, the truth involved in those data.

The syllogism then, if taken to represent the form of the inferential act, has the fundamental fault that it fails to cover the whole of the ground it professes to cover. It falls short at both ends. There are simple deliverances of reason and

complex deliverances of reason, both of them having the highest degree of certainty, which are entirely extra-syllogistic—cannot, however violently dislocated, be brought within the syllogistic form. Consequently, if it be admitted that a true expression of the ratiocinative act must be one applicable to all ratiocinative acts; it must be concluded that the ratiocinative act is not truly expressed by the syllogism.

§ 305. From indirect examinations of the syllogism, let us turn to a direct examination of it. This will quickly lead us to the same conclusion. We shall find that the syllogism is a psychological impossibility.

To get rid of all misleading implications, let us take an unhackneyed case. When I say,—

All crystals have planes of cleavage;
This is a crystal;
therefore,
This has a plane of cleavage;

and when it is asserted that this describes the mental process by which I reached the conclusion; there arises the question —What induced me to think of "All crystals"? Did the concept "All crystals," come into my mind by a happy accident, the moment before I was about to draw an inference respecting a particular crystal? No one will assert such an absurdity. It must have been, then, that a consciousness of the particular crystal identified by me as such, was antecedent to my conception of "All crystals." This, however, it will be said, is merely a formal objection; which may be met by putting the minor premiss first. True; but this objection is introductory to a fatal one. For the mind being, as we see, occupied about the individual crystal before it is occupied about the class; there result the two inquiries—(1), Why, having been conscious of the individual crystal, should I, in this particular case, go on to think of the class, crystals; instead of think

ing of some other thing? and (2), Why, when I think of the class crystals, should I think of them as having planes of cleavage; instead of thinking of them as angular, or as polished, or as brittle, or as having axes? Is it again by a happy accident that, after the individual, the class is overtly called to mind? and further, is it by a happy accident that the class is called to mind as having the special attribute I am about to predicate? No one will dare to say, yes. How happens it, then, that after the thought—"This is a crystal," there arises the thought—"All crystals have planes of cleavage;" instead of some other of the thousand thoughts which association might next bring up? There is one answer, and only one. *Before consciously asserting that all crystals have planes of cleavage, it has already occurred to me that this crystal has a plane of cleavage.* Doubtless it is the registered experience I have had respecting the cleavage of crystals, which *determines* me to think of this crystal as having a plane of cleavage; but that registered experience is not present to my mind *before* the special predication is made, though I may become conscious of it subsequently. The process of thought which the syllogism seeks to describe, *is not that by which the inference is reached, but that by which it is justified;* and in its totality is not gone through at all, unless the need for justification is suggested. Each may at once convince himself of this by watching how any of his most familiar inferences originate. It is stated that Mr. So-and-so, who is ninety years old, is about to build a new mansion; and you instantly laugh at the absurdity—a man so near death making such preparation for life. But how came you to think of Mr. So-and-so as dying? Did you first repeat to yourself the proposition—"All men must die?" Nothing of the kind. Certain antecedents led you to think of death as one of his attributes, without previously thinking of it as an attribute of mankind at large. To any one who considered Mr. So-and-so's folly not manifest, you would probably say—"He must die, and that very

shortly:" not even then appealing to the general fact. Only on being asked *why* he must die, would you either in thought or word resort to the argument—"All men die, therefore Mr. So-and-so must die."

Obviously, then, the process of thought formulated by the syllogism, is in various ways irreconcilable with the process of reasoning as normally conducted—irreconcilable as presenting the class while yet there is nothing to account for its presentation; irreconcilable as predicating of that class a special attribute while yet there is nothing to account for its being thought of in connexion with that attribute; irreconcilable as embodying in the minor premiss an assertory judgment (this is a man) while the previous reference to the class men implies that that judgment had been tacitly formed beforehand; irreconcilable as separating the minor premiss and the conclusion, which ever present themselves to the mind in relation.

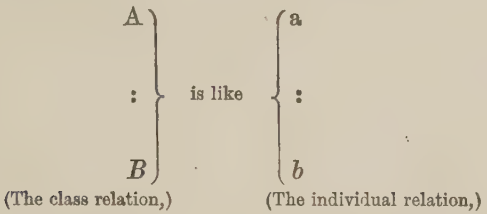
All that may rightly be claimed for the syllogism is, that by conveniently exhibiting the data, it enables us deliberately to verify an inference already drawn; provided this inference belongs to a particular class. I add this qualification because its use, even for purposes of verification, is comparatively limited. One limitation is indicated in the foregoing section; where we saw that there are many inferences of a kind so certain as to be called axiomatic, which do not admit of having their terms arranged syllogistically. This is not all. To a large class of the cases commonly formulated in syllogisms, there applies the current criticism that a *petitio principii* is involved in the major premiss; since no test of the *objective* reality of the alleged correlation is yielded, unless the *all* asserted can be asserted absolutely: the implication being that the syllogism here serves simply to aid us in re-inspecting our propositions; so that we may see whether we have asserted much more than we absolutely know, and whether the conclusion is really involved in the premisses, as we supposed. Beyond those

syllogisms in which the major premiss expresses a truth that can be known as strictly universal, the only syllogisms which can be said to formulate objective correlations in such way as helps us to test the alleged necessity of certain inferred correlations, in the quantified syllogism; and even this, though it covers a large class of necessary objective correlations, does not cover them all. Instance the one contained in this old puzzle with a new face:—Suppose there are more persons in a town than there are hairs on any one person's head; then there must be at least two persons in the town with the same number of hairs on their heads. In this implication we see very clearly the existence of those necessary objective correlations which, as above contended, form the matter of the most abstract objective science; and we see also that Logic, considered as this science, comprehends much which cannot be included in the established logical forms.

§ 306. Here ending this parenthetical discussion, which in various ways brings us to the conclusion that Logic, instead of being a science of certain subjective correlations is a science of certain objective correlations, and that syllogizing is a mode of so representing some of these objective correlations as to facilitate the observation of their interdependencies, we return to our immediate subject—the theory of Reasoning. This we have now to consider under its most general aspects; which we are all the better prepared to do after considering the general aspects of an opposed theory. Especially has a clear understanding of the matter been furthered by the criticisms set down in the last section; where I have drawn attention to a fact hitherto passed over with the view of avoiding inconvenient complication, but which must now be deliberately recognized.

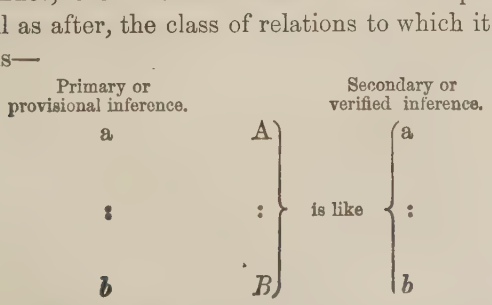
For, as some readers have perhaps already perceived, the objection made to the syllogism because its terms stand in an order unlike that followed by them in a normal act of reasoning, is partially applicable to many of the formulæ

given in preceding chapters. It may be truly said that these represent, not the primary and direct reasoning, gone through almost spontaneously without distinct assertion of the data, but the secondary and indirect reasoning, consciously gone through. To express any deduction by saying of the compared relations that,



is to raise the insuperable difficulty above suggested—that the class, with its appropriate predicate, cannot in order of thought precede the individual and that which we predicate of it; or, in other words—that we do not think of the class of before-known relations as *like* the single present relation; but we think of the single present relation as *like* the class. Just as, before writing down the proportion $\overset{\text{acres.}}{3} : \overset{£.}{162} :: \overset{\text{acres.}}{4\tfrac{1}{2}} : \overset{£.}{—}$, I must have already recognized the unknown relation sought, as equal to the known relation premised: otherwise the writing down the premised relation would be unaccountable.

Hence, to symbolize the deductive process in a complete manner, the inferred relation must be placed before, as well as after, the class of relations to which it is assimilated; thus—



The first of these three represents that act of thought in

which, on the presentation of some object (a), there is suggested to the mind some unperceived attribute (*b*), as possessed by it. This act is simple and spontaneous; resulting, not from a *remembrance* of the before-known like relations (A : *B*), but merely from the *influence* which, as past experiences, they exercise over the association of ideas. Commonly, the inference thus determined suffices us, and we pass to some other thought; but if a doubt is internally or externally suggested, then the acts of thought represented by the rest of the symbol are gone through—we have a process of conscious reasoning.

And here, respecting this series of mental acts, there occurs a consideration of some interest and importance. It is universally admitted that induction must precede deduction—that we cannot descend from the general to the particular, until we have ascended from the particular to the general. The fact now to be remarked is, that not only of reasoning in its *ensemble* does this hold, but also, in a qualified sense, of each particular inference. A few pages back it was pointed out that as, in the development alike of the general mind and the individual mind, qualitative reasoning precedes quantitative reasoning; so, each particular act of quantitative reasoning grows out of a preceding act of qualitative reasoning. We are now introduced to the analogous law that as, in mental progress, both general and particular, induction precedes deduction; so, every particular act of deduction properly so called, implies a preparatory act of induction. For may we not properly say that the mental transition from the spontaneously-inferred relation with which every deductive process must commence, to the class of relations it belongs to, parallels the act by which the mind originally passed from particular relations to the general relation? True, the particular relation is now not an observed one; and in so far the parallel does not hold. Still, it is conceived as existing; and only because it is so conceived does the class of such relations come

into consciousness. The sequence of thought follows the channel through which the induction was before reached. As each separate deductive act involves an ascent from the particular to the general, before the descent from the general to the particular, the historic relation between induction and deduction is repeated. In all cases of deduction there is either an induction made on the spur of the moment (which is often the case), or there is an automatic re-thinking of the induction before made.

Resuming our immediate topic, it is to be remarked that the amended, or rather completed, form under which the deductive process is above represented, remains in perfect accordance with the doctrine developed in foregoing chapters, that reasoning is carried on by comparison of relations. For whether the singular relation is thought of before the plural, or the plural before the singular, or first one and then the other; it remains throughout manifest that they are thought of as like (or unlike) relations, and that the possibility of the inference depends on their being so thought of.

§ 307. And now, that the truth of the doctrines enunciated in foregoing chapters may be still more clearly seen, let us glance at the series of special results that have been reached, and observe how harmoniously they unite as parts of one whole.

We noticed that perfect quantitative reasoning, by which alone complete previsions are reached, involves intuitions of coextension, coexistence, and connature, in the things reasoned about; besides connature and cointension in the compared relations. In other words, we saw that in this highest reasoning there is equality among the terms in Space, Time, Quality, and among their relations in kind and degree; and that thus not only does the idea of likeness rise to its greatest perfection (equality), but it appears under the greatest variety of applications. While we saw

that in imperfect quantitative reasoning where non-coextension is predicated, either indefinitely (these magnitudes are unequal) or definitely (this magnitude is greater than that), the idea of exact likeness is no longer so variously involved. We next found that in perfect qualitative reasoning, the intuition of coextension ceases to appear, though there is still coexistence and connature among the terms, along with connature and cointension among the relations subsisting between those terms; and that thus there is another diminution in the number of implied intuitions of equality. And further we found that in parti-perfect qualitative reasoning, where non-coexistence is predicated either indefinitely (these things do not exist at the same time) or definitely (this follows that), the number of such implied intuitions is again reduced; though there yet remains equality in the natures of the things dealt with, and in the natures of the compared relations. We have now to notice, what was not noticed in passing, that in imperfect qualitative reasoning we descend still lower; for in it, we have no longer complete equality of nature among the terms of the compared relations. Unlike lines, angles, forces, areas, times, &c., the things with which ordinary class-reasoning deals are not altogether homogeneous. The objects grouped together in an induction are never exactly alike in every one of their attributes; nor is the individual thing respecting which a deduction is made, ever quite indistinguishable in character from the things with which it is classed. No two men, or trees, or stones, have the same absolute uniformity of nature that two circles have. Similarly with the relations between terms of such kinds: though they remain connatural, they do not remain cointense. And thus in our contingent every-day inferences, we have only likeness of nature in the entities and attributes involved; equality of nature in the relations between them; and more or less of likeness in the degrees of those relations. The subjects must be like;

the things predicated of them must be like; and the relations must be homogeneous, if nothing more. Even when we come to the most imperfect reasoning of all—reasoning by analogy—it is still to be observed that, though the subjects and predicates have severally become so different that not even likeness of nature can be safely asserted of them, there still remains likeness of nature between the compared relations. If the premised relation is a sequence, the inferred one must be a sequence; or they must be both coexistences. If one is a space-relation and the other a time-relation, reasoning becomes impossible. As a weight cannot be compared with a sound, so there can be no comparison between relations of different orders. This fact, that as we descend from the highest to the lowest kinds of reasoning, the intuitions of likeness among the elements involved become both less perfect and less numerous, but never wholly disappear, will hereafter be seen to have great significance.

Passing from the elements of rational intuitions to their forms, we find that these are divisible into two genera. In the one the compared relations, having a common term, are conjoined; and in the other the compared relations, having no common term, are disjoined. Let us glance at the several species comprehended under the first of these genera. Having but three terms, these have for their types the forms—

$$A : B \text{ is equal to } B : C;$$

its indefinite negation,

$$A : B \text{ is unequal to } B : C;$$

and its definite negation,

$$A : B \text{ is } \left\{\begin{matrix}\text{greater}\\ \text{or less}\end{matrix}\right\} \text{ than } B : C.$$

Suppose in the first of these forms, A, B, and C represent magnitudes of any order; then, if they are severally equal, we have the axiom—"Things that are equal to the same

thing are equal to each other;" and if they are severally unequal, we have a case of mean proportionals. In the second form, if A, B, and C are magnitudes, we have the converse of the above axiom; while the thing determined is the inequality of A and C. And in the third form, the thing determined is the superiority or inferiority of A to C. Again, suppose A, B, and C are times, either at which certain things continuously exist or at which certain events occur; then, the first form represents the axioms—"Things that coexist with the same thing coexist with each other," and "Events which are simultaneous with the same event are simultaneous with each other." The second form stands for the converse axioms; and predicates the non-coexistence or non-simultaneity of A and C. While the third symbolizes cases in which A is concluded to be before or after C. To make these facts clear, let us formulate each variety.

SPACE-RELATIONS.

A is equal to B; B is equal to C; therefore A is equal to C.

A is equal to B; B is unequal to C; therefore A is unequal to C.

A is equal to B; B is {greater / or less} than C; therefore A is {greater / or less} than C.

A is {greater / or less} than B; B is {greater / or less} than C; therefore A is {greater / or less} than C.

TIME-RELATIONS.

A {is simultaneous with} B; B {is simultaneous with} C; therefore A {is simultaneous with} C.

A {is simultaneous with} B; B {is not simultaneous with} C; therefore A {is not simultaneous with} C.

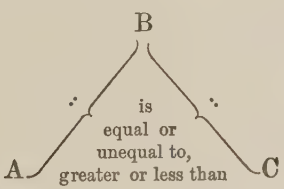
(and similarly if there is coexistence instead of simultaneity)

A {is simultaneous with} B; B is {before or after} C; therefore A is {before or after} C.

A is {before or after} B; B is {before or after} C; therefore A is {before or after} C.

It must not be supposed, however, that Time-relations and Space-relations are the only ones that can enter into

these forms. Relations of Force, under its various manifestations, may be similarly dealt with. To use the Kantian nomenclature, there is Extensive quantity (in Space); Protensive quantity (in Time); and Intensive quantity (in the degree of the Actions that occur in space and time). It is true, as before shown, (§ 25) that intensive quantities, as those of weight, temperature, &c., cannot be accurately reasoned about without substituting for them quantities of extension, as by the scales and the thermometer; but it is none the less true that there is a simple order of inferences respecting intensive quantities, exactly parallel to those above given. If, for example, a ribbon matched in colour some fabric left at home, and matches some other fabric at the draper's, it is rightly inferred that these fabrics will match each other; or if, on different occasions, a piece of music had its key-note pitched by the same tuning-fork, it is to be concluded that the pitch was alike on both occasions. Similarly in various other cases, which it is needless to specify. In all of them, as well as in the cases above given, the intuition, both in its positive and negative forms, is represented by the symbol—



The only further fact of importance to be named respecting this genus of rational intuitions is, that not only are the two relations homogeneous in nature, but all the three terms are so likewise. Whence, in part, arises the extremely-limited range of conjunctive reasonings.*

* I ought here to mention that some year and a half since (this was written in 1855), in the course of a conversation in which the axiom—"Things that coexist with the same thing coexist with each other," was referred to, it was remarked by a distinguished lady—the translator of

The other genus of rational intuitions, distinguished by having four terms, and therefore two separate or disjoined relations, is represented by the typical forms—

A : B is equal to C : D;
its indefinite negation,
A : B is unequal to C : D;
and its definite negation,
A : B is $\left\{\begin{matrix}\text{greater}\\ \text{or less}\end{matrix}\right\}$ than C : D.

To which must be added the two modified forms which result when the reasoning is imperfect—

A : B is like C : D;
and its negation,
A : B is unlike C : D.

Supposing, in the first of these five, the letters represent homogeneous magnitudes; then, when A equals B, and C equals D, we have a representation of the several axioms—If equals are added to, subtracted from, multiplied by, &c.,

Strauss and Feuerbach (now universally known as George Eliot)—that perhaps a better axiom would be—"Things that have a constant relation to the same thing have a constant relation to each other." Not having at that time reached the conclusion that a formula having but three terms cannot express our ordinary ratiocinations, which involve four; I was greatly inclined to think this the most general truth to which the propositions known by reason are reducible: the more so as, being expressed in terms of relations, it assimilated with many results at which I had already arrived in the course of analyzing the lower intellectual processes. As will appear, however, from the preceding chapters, subsequent inquiry led me to other conclusions. Nevertheless, this suggestion was of much service in directing my thoughts into a track which they might not else have followed. Respecting this axiom itself, it may be remarked that as the word *constant* implies *time* and *uniformity*, the application of the axiom is limited to necessary time-relations of the conjunctive class. But if, changing the word constant for a more general one, we say—Things which have a definite relation to the same thing have a definite relation to each other; we get an axiom which expresses the most general truth known by conjunctive reasoning—positive and negative, quantitative and qualitative.

equals, the results are equal; and when each of the two ratios is not one of equality, we have an ordinary proportion. Supposing that the four terms are not homogeneous throughout, but only in pairs, then the formula stands for common geometrical reasoning; and when the things represented are not magnitudes, but simply entities and attributes that are alternately homogeneous, we have the reasoning by which necessary coexistences and sequences are recognized. Again, in the second and third forms, if all the terms are homogeneous magnitudes, inequations and certain axioms antithetical to the above are symbolized; if the magnitudes are but alternately homogeneous, there is typified that imperfect geometrical reasoning by which certain things are proved always greater or less than certain others; and when the letters stand not for magnitudes but simply for entities, properties, or changes, we have that species of necessary qualitative reasoning which gives negative predications. Lastly, by the fourth and fifth forms are signified all orders of class-reasoning; from that which is next to necessary to that which is in the highest degree problematical: inclusive alike of Induction, Deduction, Analogy, and Hypothesis. All these sub-genera and species of Disjunctive Reasoning are representable by the one symbol—

$$\left.\begin{matrix} A \\ : \\ B \end{matrix}\right\} \begin{matrix} \text{is equal or unequal to,} \\ \text{greater or less than,} \\ \text{like or unlike,} \end{matrix} \left\{\begin{matrix} C \\ : \\ D \end{matrix}\right.$$

And the several varieties may be classified in three distinct modes, according as the basis of classification is—(1) the *degree of resemblance* between the two relations; (2) the *nature* of the compared relations; and (3) the comparative *number* of the premised and inferred relations. Under the first of these classifications, we have the divisions—Positive

and Negative; Perfect, Parti-perfect, and Imperfect; Necessary and Contingent; Analogical. Under the second, we have the two great divisions—Quantitative and Qualitative; of which the one may be Proportional, Algebraic, or Geometrical, according as the terms of each relation are or are not homogeneous, and are or are not equal; and of which the other may refer to either coexistences or sequences, whether between attributes, things, or events. Under the third, we have reasoning divided into Inductive, Deductive, Hypothetical; which are classifiable according to the numerical ratio between the premised and inferred relations, as follows:—

Premised Relations.	Inferred Relations.	
If from *one*	to *one*,	the reasoning is from particulars to particulars; and is valid or doubtful according to the natures of the terms.
If from *one*	to *all*,	we have a species of induction that is valid or doubtful according to the natures of the terms.
If from *few*	to *all*,	it amounts to ordinary Hypothesis.
If from *many*	to *all*,	it is Induction proper.
If from *some*	to *one*,	it is what we may call Hypothetical deduction.
If from *all*	to *one*,	it is Deduction proper.
If from *all*	to *some*,	

Respecting the disjunctive form of reasoning one further remark should be made; namely, that it includes certain inferences which can be classed neither with the inductive, the deductive, the process from particulars to particulars, nor any of their modifications. These are the inferences at once drawn, and correctly drawn, without an established truth for a premiss, and in cases that have not been before paralleled in experience. Thus, if A be but a fiftieth part less than B, it is at once inferable that a

half of A is greater than a third of B. Neither a general principle nor a particular experience, can be quoted as the ground for this conclusion. It is reached directly and independently by a comparison of the two relations named; and is satisfactorily explicable neither on the hypothesis of forms of thought, nor on the experience-hypothesis as ordinarily interpreted. We may aptly term it a *latent* inference; and its genesis, like that of many others, is to be properly understood only from that point of view whence these antagonist hypotheses are seen to express opposite sides of the same truth. Of this more in the sequel. Here it is to be observed that while the species of reasoning thus exemplified is obviously effected by comparison of relations, and so conforms to the theory above set forth, it does not conform to any of the current theories.

Respecting those most involved forms of reasoning analyzed in the first chapter, which deal not with the quantitative or qualitative relations of things, but with the quantitative relations of quantitative relations, it is needless now to do more than remind the reader that they arise by duplication of the forms above given; and that in their highest complications they follow the same law. Perceiving as he thus will that the doctrine set forth applies to all orders of reasoning—from the simplest to the most complex; from the necessary to the remotely contingent; from the axiomatic to the analogical; from the most premature induction to the most rigorous deduction—he will see that it fulfils the character of a true generalization: that, namely, of explaining all the phenomena.

§ 308. One other group of confirmatory evidences deserves notice—the group supplied by our ordinary forms of speech. Already some of these evidences have been incidentally pointed out. They are so numerous and so significant, that even standing alone they would go far to justify the doctrine which has been developed.

Thus we have the Latin *ratio*, meaning reason; and *ratiocinor*, to reason. This word *ratio* we apply to each of the two quantitative relations forming a proportion; and the word *ratiocination*, which is defined as "the act of deducing consequences from premisses," is applicable alike to numerical and to other inferences. Conversely, the French use *raison* in the same sense that *ratio* is used by us. Throughout, therefore, the implication is that *reason*-ing and *ratio*-ing are fundamentally identical. Further, be it remarked that *ratiocination*, or reasoning, is defined as "the *comparison* of propositions or facts, and the deduction of inferences from the comparison." Now every proposition, or asserted fact, involving as it does a subject and a something predicated of it, necessarily expresses a relation. Hence the definition may properly be transformed into, "the comparison of relations, and the deduction of inferences from the comparison." But the only thing effected by comparison is a recognition of the likeness or unlikeness of the compared things; and therefore inferences said to be deduced from the comparison, must result from the recognition of the likeness or unlikeness of relations. Again, we have the word *analogy*, applied alike to proportional reasoning in mathematics and to the presumptive reasoning of daily life. The meaning of analogy is, "an *agreement* or *likeness* between things in some circumstances or effects, when the things are otherwise entirely different;" and in mathematics, an analogy is "an agreement or likeness between" two ratios in respect of the quantitative contrast between each antecedent and its consequent. So that in either case, to "deny the analogy," is to deny the assumed likeness of relations. Then we have the common expressions—"by *parity* of reasoning," and "the cases are not upon a *par*." Parity means *equality*; and being upon a par means being upon a *level;* so that here, too, the essential idea is that of likeness or unlikeness. Note, also, the familiar qualifications—"*cæteris paribus*," "other things equal;" which are used with the implication that

when all the remaining elements of the compared cases stand in like relations, the particular elements in question will stand in like relations. There is the notion of parallelism, too. It is an habitual practice in argument to draw a *parallel*, with the view of assuming in the one case what is shown in the other. But parallel lines are those that are always *equi*-distant—that are *like* in direction; and thus the fundamental idea is still the same. Yet another group of words has significance. Men reason by *similes* of all orders, from the parable down to the illustration; and *similarity* is constantly the alleged ground of inference, alike in necessary and in contingent reasoning. When geometrical figures are known to be similar, and the ratio of any two homologous sides is given, the values of all the remaining sides in the one, may be inferred from their known values in the other; and when the lawyer has established his precedent, he goes on to argue that *similarly*, &c. Now as, in geometry, the definition of similarity is, equality of ratios among the answering parts of the compared figures; it is clear that the similarity on the strength of which ordinary inferences are drawn, means—likeness of relations. Once more there is the language used to express *proportion*. Not only is the process of thought by which both our simplest and our most complex conclusions are reached, fundamentally one with that employed in proportional reasoning; but its verbal expression often simulates the same form. As in mathematics we say—*As* A is to B, *so* is C to D; so in non-quantitative reasoning we say —*As* a muscle is strengthened by exercise, *so* is the rational faculty strengthened by thinking. Indeed, this sentence supplies a double illustration; for not only does each of the two inferences it compares exhibit the proportional form, but the comparison of them itself exhibits that form.

Thus words and phrases afford us consistent testimony. It is manifest, that our habitual modes of expression bear witness to the truth of the foregoing analysis.

§ 309. And now, as an appropriate finish to this lengthened exposition, let me point out how the conclusion we have come to may be reached even *à priori*. When, towards the close of this Special Analysis, we look at the ultimate elements of consciousness, it will be abundantly manifest that the phenomena of reasoning cannot be truly generalized in any other way. But without waiting for this most conclusive proof eventually to be arrived at, it may be demonstrated in two ways that every inference involves an intuition of the likeness or unlikeness of relations. Already, incidental reference has been made to these *à priori* arguments; but they claim a more definite statement than they have hitherto received.

Both of them are based on the very definition of reason, considered under its universal aspect. What is the content of every rational proposition? Invariably a predication—an assertion that something is, was, or will be, conditioned (or not) in a specified manner—that certain objects, forces, attributes, stand to each other thus or thus, in Time or Space. That is, every rational proposition expresses *some relation*. But how only is a relation thinkable? It is thinkable only as of a certain *order*—as belonging to some *class* of before-known relations. It must be with relations as with their terms; which can be thought of as such, or such, only by being thought of as members of this or that class. To say—"This is an animal," or "This is a circle," or "This is the colour red;" necessarily implies that animals, circles, and colours have been previously presented to consciousness. And the assertion that this is an animal, a circle, or a colour, is a grouping of the new object perceived with the similar objects remembered. In like manner the inferences—"That berry is poisonous," "This solution will crystallize;" are impossible even as conceptions, unless a knowledge of the relations between poison and death, between solution and crystallization, have been previously put into the mind; either immediately by expe-

rience or mediately by description. And if a knowledge of such relations pre-exists in the mind, then the predications —"That berry is poisonous," "This solution will crystallize;" imply that certain new relations are thought of as belonging to certain classes of relations. It follows that, contemplated from this point of view, *reasoning is a classification of relations*. But what does classification mean? It means the grouping together those which are *like*—the separation of the *like* from the *unlike*. Briefly, then, when inferring any relation, we are obliged to think of it as one (or not one) of some class of relations; and to think of it thus, is to think of it as like or unlike certain other relations.

Passing to the second *à priori* argument, let us consider what is the more specific definition of Reasoning. Not only does the kind of proposition called an inference, assert a relation; but every proposition, whether expressing mediate or immediate knowledge, asserts a relation. How, then, does knowing a relation by Reason differ from knowing it by Perception? It differs by its *indirectness*. A cognition is distinguishable as of one or the other kind, according as the relation it embodies is disclosed to the mind *directly* or *indirectly*. If its terms are so presented that the relation between them is immediately cognized—if their coexistence, or succession, or juxtaposition, is knowable through the senses; we have a perception. If their coexistence, or sequence, or juxtaposition, is not knowable through the senses—if the relation between them is mediately cognized; we have a ratiocinative act. Reasoning, then, is *the indirect establishment of a definite relation between two things*. But now the question arises —By what process can the indirect establishment of a definite relation be effected? There is one process, and only one. If a relation between two things is not directly knowable; it can be disclosed only through the intermediation of relations that are directly knowable, or are already

known. Two mountains not admitting of a side by side comparison, can have their relative heights determined only by reference to some common datum line; as the level of the sea. The connexion between a certain sound and the blowing of a distant horn, can arise in the mind only by the help of a before-perceived connexion between such a sound and such an action. Observe, however, that in neither case can any progress be made so long as the relations are separately contemplated. Knowledge of the altitude of each mountain above the sea, gives no knowledge of their relative altitudes, until the two relations of their tops to the sea are thought of together, as having a certain relation. The remembrance that a special kind of sound is simultaneous with the blowing of a horn, leads to nothing unless this general relation is thought of in connexion with the particular relation to be inferred. Hence, every ratiocinative act is *the indirect establishment of a definite relation between two things, by the process of establishing a definite relation between two definite relations.*

These truths — That Reasoning, whether exhibited in a simple inference or in a chain of such inferences, is the indirect establishment of a definite relation between two things; and that the achievement of this is by one or many steps, each of which consists in the establishment of a definite relation between two definite relations; embody, under the most general form, the various results arrived at in previous chapters.*

* A brief statement of the theory of Reasoning here elaborated in detail, will be found in an essay on "The Genesis of Science," published in the *British Quarterly Review*, for July, 1854 (since republished, with other essays in a permanent form). In that essay I have sought to show that scientific progress conforms to the laws of thought here set forth. It contains accumulated illustrations of the fact that the discoveries of exact science, from the earliest to the latest, severally consist in the establishment of the equalities of relations. That the progress of human reason, as viewed in its concrete results, should throughout exemplify this generalization, as it does in the clearest manner, affords further confirmation of the foregoing analysis.

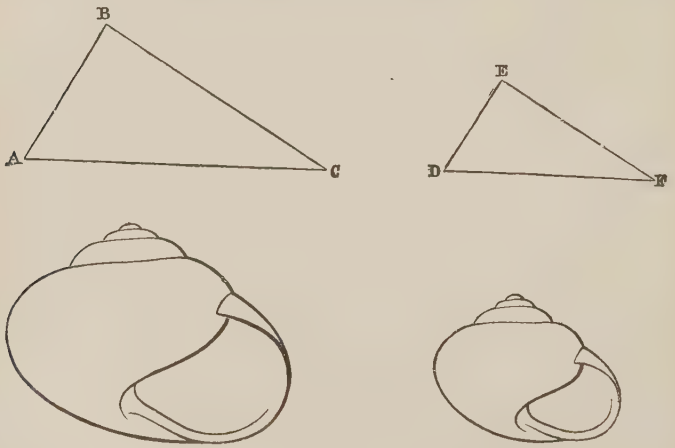
CHAPTER IX.

CLASSIFICATION, NAMING, AND RECOGNITION.

§ 310. I need scarcely recall the closing section of the last chapter for the purpose of showing that there is a close alliance between Reasoning and Classification; for every student of Reasoning had this truth thrust upon him at the outset of his studies. The alliance is much closer than is supposed, however. Their dependence is reciprocal—Reasoning presupposes Classification, and Classification presupposes Reasoning. This statement seems to involve a contradiction; and would do so, were Reasoning and Classification wholly distinct things. But the solution of the apparent paradox lies in the fact that they are different sides of the same thing—are the necessary complements of each other. Already in describing reasoning as the classification of relations, its near approach to the classification of entities has been implied. And if we remember that on the one hand, classification of relations involves classification of the things or attributes between which they subsist, while, on the other hand, classification of entities involves classification of the relations among their constituent attributes; the kinship of the two will appear still closer. Let us compare them in detail.

The idea underlying all classification is that of *similarity*. When we group an object with certain others, we do so because in some or all of its characters it resembles them

Whether it be in putting together as of one kind, the extremely-like individuals constituting a species; whether it be in uniting under the general division, *Vertebrata*, such diverse creatures as a fish and a man, a snake and a bird; or whether it be in regarding both animate and inanimate objects as members of the great class, solid bodies; there is always *some* community of attributes—always *some* similarity in virtue of which they are colligated. But, as was lately pointed out, similarity in its strictest sense means equality of relations, and in its less strict sense means likeness of relations. When it is said that the two triangles ABC, DEF, are similar, the specific assertion involved is, that AB is to BC, as DE to EF; or, generally, that the quantitative relation between any two sides of the one, is equal to that between the homologous sides of the other.



And when the two annexed shells are classed as of the same species, the implied perception of similarity is a perception that the relations among the several parts of the one are equal to, or like, those among the homologous parts of the other: not only the space-relations, but to a great extent the relations among colours, textures, and so on. What,

then, is the difference between these acts of thought? From the perception of similarity in the triangles, there is evolved an inference respecting the value of some side; and from the perception of similarity in the shells, there is evolved the idea of identity of class. How is this? An answer is easily found. Similarity has several implications. After the perception of similarity any one of these may present itself to consciousness; and according as one or other of the two leading kinds of implication is thought of, we have reasoning or we have classification. It is impossible to perceive anything to be similar to another, or others, without, to some extent, thinking of that other, or those others. At the same time it is impossible to perceive similarity between things, without being more or less conscious of that likeness of relations among their elements which constitutes their similarity. Either of these two latent implications may become the subject of distinct contemplation. If we consciously recall the things to which this particular one is similar, we classify; if, consciously dwelling on the likeness of relations, we think of certain implied attributes, we reason.

"But how," it may be asked, "does this prove that classification presupposes reasoning; as well as that reasoning presupposes classification? It may be true that the intuition of similarity is their common root. It may be true that our conscious inferences involve acts of classing. But it does not, therefore, follow that our conscious acts of classing involve inferences." The reply is, that in all ordinary cases the majority of the like relations in virtue of which any object is classed with certain before-known objects, are not presented in perception but represented in an act of reason. The structural, tangible, gustable, ponderable, and other sensible characters ascribed to an orange, are not included in the visual impression received from the orange; but, as all admit, are inferred from that impression. Yet these various inferred characters are included in the

concept—an orange. When I reach out my hand towards this reddish-yellow something, under the belief that it is juicy, and will slake thirst, I have already, in judging it to be an orange, conceived it as having various attributes besides the observed attributes; every one of which I know to exist, only by the same process that I know the juiciness to exist. The act of classing, then, involves a whole group of inferences; of which the particular inference avowedly drawn is only one. And had some other been drawn, as that the taste was sweet, what is now distinguished as the inference would have been one of the data; that is, one of the attributes involved in the judgment—this is an orange. Should it be said that these various unspecified attributes are not inferred in the act of classing, but that the entire thought implied is—All reddish-yellow, spherical, polished, pitted bodies of a certain size are juicy; the untruth of the position will be seen on remembering what takes place if a mock-orange made of painted stone is laid hold of. The *unexpected* weight and hardness, instantly lead to a change of classification: it is at once perceived that the body is not an orange. And this fact proves that something else than juiciness had been inferred; had been wrongly inferred; and had involved a wrong classification.

And here we see another vice of the theory which identifies syllogizing with reasoning. That theory proceeds upon the supposition that the act of referring any individual object to a class, is not an act of inference. The constant assumption is that the minor premiss, "This is a —," is immediately known; whereas it is always known mediately. Reasoning is already involved in the cognition of the very data out of which reasoning is said to be evolved. On the hypothesis that the syllogism represents the entire ratiocinative process, it is contended that its conclusion is necessary. Meanwhile, the all-essential fact which it posits as the foundation of that conclusion, is

itself known by an unexpressed ratiocination. The concluded fact, and the fact from which it is concluded, stand on the same footing. The proposition—That which I see is an orange, has no greater certainty than the proposition —That which I see is juicy. The visual impressions of shape, size, colour, and surface, received from it, form the sole ground for both propositions. The wider inference—It is an orange, can give no extra validity to the narrower inference—It is juicy; seeing that for the first there is no more evidence than for the last. Yet the doctrine of the syllogism implies that the one is the warrant for the other—implies that I can *directly* know that this something belongs to the class oranges, and, by so doing, can *indirectly* know that it is juicy!

No such insuperable difficulty stands in the way of the theory that has been enunciated. A consciousness of similarity, underlying at once the act of classification or general inference, and the act of ratiocination which gives any special inference, is the basis of either or both. Along with the visible attributes of an orange, there are mentally represented in various degrees of distinctness, some, many, or all of the attributes before found in relation with such visible attributes; and, according to the mode in which they are represented, the thing predicated is the class, or some one or more of the attributes. Let the unperceived attributes be thought of in their totality, without any of them becoming specially prominent to consciousness; then, the object in being mentally endowed with all the characteristics of its class, is conceived as one of that class, or is classified. Let a single unperceived attribute, or a single group of such attributes, arrest consciousness, and occupy it to the partial exclusion of the other unperceived attributes; then, we have a special inference, or what is verbally embodied as such. Of course the two processes being thus related, run into each other so readily and rapidly that probably neither ever occurs without the other. It is

scarcely possible that the aggregate of unperceived attributes should be thought of, without some of them being represented more vividly than the rest; and it is scarcely possible that any one of them should so engross the mind as to banish all others entirely. Always the attribute inferred has for its indistinct back-ground, those many accompanying attributes which constitute the conception of the object as one of a class; and always among the many attributes united in this classing conception, some stand out as incipient inferences. A latent classing accompanies the inferential act; latent inferences accompany the act of classing; and each continually arousing the other, alternates with it in consciousness.

Our conclusion, then, is perfectly consistent with all that has gone before; and, indeed, serves as a complement to it. Likeness of relations is the intuition common to reasoning and classification; and it results in one or the other, according as the relations thought of are partial or total.

§ 311. If we regard the name of a thing as a kind of conventional attribute, it will be manifest that when the thing is presented, this conventional attribute becomes known as any unseen real attribute becomes known—by an act of inference. The immediately-perceived properties are thought of as standing towards various unperceived properties in relations like those previously experienced; and among these unperceived properties, is that of calling forth from human beings a certain articulate sound—the name. It is true that this property is not inherent, but depends on an almost fortuitous relation established between the thing and a limited class of minds. But the like is true of various other properties which we commonly ascribe to the thing itself. As all admit, the so-called secondary qualities of body are not intrinsic, but are the affections produced in our organs by unknown agents; and they so vary that the same thing may seem heavy or light, warm or cold, pleasant or disagree-

able, according to the age, state, or character of the individual. If, then, these subjective and partially-incidental affections are called attributes of the objects affecting us, and are often ascribed to them inferentially; we may say that the purely subjective and mainly-incidental affection which an object produces in us when it suggests its name, is also in a strained sense an attribute, and becomes known by a similar mental process.

But it is by no means necessary to the argument that names should be thus considered as factitious attributes. The fact that the articulate sound by which an observed object is known, arises in consciousness after the same manner that an unperceived attribute does, may be rendered manifest without seeking any kinship between the things themselves. Observe what happens with a child. The word *orange*, which it probably first hears on a sample of that fruit being given to it, and which is often repeated in connexion with similar sensible characters, is established in its mind as a phenomenon having a more or less constant relation to the various phenomena which the orange presents. Not having as yet any notions of necessary and accidental relations, the particular sound accompanying the particular appearances, is as much grouped with them as the particular taste is. When the particular appearances recur, a relation (like the previously-experienced relation) between them and this sound, is as likely to be formed in consciousness as a relation between them and the taste. The mental act is essentially the same; and though subsequent experiences modify it in so far as the resulting conception is concerned, they cannot alter its fundamental nature. The genesis of the thought by which a thing is named remains identical in form; and to the last, as at the first, likeness of relations is the intuition implied in it.

Still more manifest becomes the kinship between naming and reasoning, when we call to mind that originally a name is a copy of some real attribute of the thing named. It is

inferable alike from the prattling of children and from the speech of savages, that all language is in the beginning mimetic. Wherever we can trace to their origin the symbols used to convey thoughts—whether it be in the infantine habit of naming animals by imitating their cries; whether it be in the signs spontaneously hit upon by deaf-mutes, or in those by which travellers in strange lands express their wants; whether it be in the dramatic gestures used by the uncivilized man to eke out his imperfect vocabulary, or in the simulative words of which that vocabulary so largely consists—we see that the notion of likeness underlies all language, and also that the symbols of thought, both vocal and mechanical (and even literal also), are at first *reproductions* of the things signified. And if names, in their earliest forms, are either directly or metaphorically descriptive of one or more distinctive attributes; then, primarily, an act of naming is an inference becoming vocal. If a Bosjesman, catching sight of some wild animal, conveys the fact to his fellows by pointing towards it and mimicking the sound it is known to make; beyond doubt this sound came into his mind as an inferred attribute. And it differs from any other inferred attribute solely in this, that instead of being simply represented in his consciousness it is re-represented by his voice. Thus beyond the fact that to ourselves the name of a thing occurs in thought just as any inferred attribute occurs, we have the fact that, originally, a name was *literally* an inferred attribute transformed—was an inference which, arising in the mind of one man by a representative act, was forthwith presentatively conveyed by him to other men.*

Developing as language does by insensible modifications

* When this passage was written (1854), I had the advantage only of such scattered illustrations as general reading had furnished. I did not know how abundant and various was the evidence that might be brought in support of the proposition it embodies. In the recent work of Mr. Tylor on *The Early History of Mankind*, large accumulations of such evidence will be found.

and complications out of this primitive process of naming, it follows throughout the same general law. Almost losing, though it ultimately does, the marks of its inferential genesis, it needs but to watch the use of new metaphors and the coining of new words, to see under a disguised form, the same fundamental intuition of likeness of relations.

§ 312. From the acts of Classification and Naming, let us pass to the act of Recognition. When the relations subsisting among any group of attributes are not simply *like* the relations subsisting among some before-known group, but are in most, if not in all respects, *equal* to them; and when the attributes themselves (as those of height, breadth, colour, &c.) are also *equal;* then we conclude the object presenting them to be the *same* object which we before knew.

Recognition differs from classification partly in the fact that the two compared groups of relations usually present a much higher degree of likeness, but mainly in the fact that not only are the relations alike but the constituent attributes are alike. There are two kinds of differences which objects display: differences between their sensible properties, as considered separately; and differences between the modes in which these sensible properties are co-ordinated, or related to one another. And if there are no discernible differences between the corresponding properties or the corresponding relations, we know the object as one previously perceived—we identify it—we recognize it. To speak more specifically—If, passing over all those wider classes, such as minerals, plants, &c., whose members present very few relations in common; and those narrower but still very comprehensive classes, such as houses, crystals, quadrupeds, which have more decided similarities; and again, those yet narrower ones called genera—if, passing over all these, we confine our attention to those narrowest classes which severally contain individuals of the same kind, as asses, fir-trees, balloons; we see that while in

respect of each attribute there need not be equality, there must be equality, or at least extreme likeness, in respect of the mode in which the attributes are combined. Whether the ass be six feet long or four feet long—whether dark brown or light brown, does not affect the classification; providing the *proportions* of its body and limbs in their ensemble and details, are nearly the same as those of other asses. It matters not whether the height of the fir-tree be five feet or a hundred feet; it is still classed as a fir-tree, if the *relations* of the branches to each other and to the stem, in position, direction, and length, together with the proportions and groupings of the pin-shaped leaves, are like those of fir-trees in general. But that a particular thing or place should be identified as a thing or place before seen, implies (in most cases) not only that the elements which compose the perception stand to one another in relations that are indistinguishable from the remembered relations; but that each element individually is indistinguishable from the remembered element answering to it.

I say in most cases, because our experience of the changeableness of things often leads us to assert identity where, besides some failure of likeness between the perceived and the remembered attributes, there is even some failure of likeness between the relations in which they stand to one another. Though, if the body be inanimate, we look for sameness in the dimensions and their several ratios, we are not prevented from knowing it again by the absence of a corner, or by some change of colour, or by the loss of polish. And an animate body may be recognized as a particular individual, even though it has greatly altered in bulk, in colour, and even in proportions—even though a limb has disappeared, the face become thin, and the voice weak. But when, as here, the identity is perceived in virtue of some very distinctive attributes and relations which remain unaltered, it is manifest that the impressions are interpreted by the help of sundry generali-

zations respecting the changes to which certain classes of bodies are liable; and that thus the act of simple recognition, properly so called, is greatly disguised. It should be remarked, too, that in cases of this kind the distinction between Recognition and Classification is very liable to disappear. It frequently becomes a question whether the observed object is the one before seen, or another of the same class.

But we shall best see what are the requisites to Recognition, by taking a case in which an individual cannot be recognized because of its extreme likeness to the other individuals constituting the class. Suppose that, while taking a needle from among sundry others of the same size, the whole paper-full is dropped on the floor To fix upon the one which was about to be taken, is known to be hopeless. Why? Because the needles are so exactly alike in all respects, that no one of them is distinguishable from the others. Classification and Recognition here merge into one; or rather, there is no recognition of the individual, but only of the species. Suppose, now, that the selected needle is a larger one than the rest. What follows? That it can be readily identified. Though it may be perfectly *similar* to the others—though the ratios of the several dimensions to one another may be exactly *like* the homologous ratios in the rest—though there may be complete *equality of relations* among the attributes; yet these attributes, separately considered, differ from the corresponding attributes in the others. Hence the possibility of recognition. In this case we see both the positive conditions under which only recognition can take place, and the negative conditions. We see not only that the object identified must re-present a group of phenomena just like a group before presented; but also that there must be no other object presenting a group which is just like.

Of course it follows that Recognition, in common with Classification, is a modified form of reasoning. I do not

mean that reasoning is involved in cases where great change has taken place, as where a tree that has wholly outgrown recollection is identified by its relative position; but I mean that where the recognition is of the simplest kind—where the recognized object is unaltered, there is still a ratiocinative act implied in the predication of its identity. For what do we mean by saying of such a thing that it is the *same* which we before saw? And what suffices us as proof of the sameness? The conception indicated by the word *same*, is that of a definite assemblage of correlated phenomena, not *similar to* a before-known assemblage, but *indistinguishable from* a before-known assemblage. On perceiving a group of attributes answering in all respects to a group perceived on a previous occasion, and differing in some respects from all allied groups, we *infer* that there coexists with it a group of unperceived attributes that likewise answer, in all respects, to those previously found to coexist with the perceived group. Should any doubt arise as to the identity of the object, then, by more closely inspecting it, by feeling it, by examining its remote side, by looking for a mark before observed, we proceed to compare the inferred attributes with the actual ones; and if they agree, we say the object is the same. While from minute to minute throughout our lives we are presented with groups of phenomena differing more or less from all preceding groups, we are also continually presented with groups of phenomena that are indistinguishable from preceding groups. Experience teaches us that when the perceived portion of one of these groups is indistinguishable from the corresponding portion of one before perceived; then, the remaining portions of the two are also indistinguishable. And the act of recognition is simply an inference determined by this general experience, joined to that particular experience which the recognition presupposes.

So that, regarding them both as forms of reasoning, Recognition differs from Classification simply in the greater

speciality and definiteness of the inferred facts. In classing an observed object as a book, the implied inference is that along with certain visible attributes there coexist such others as the possession of white leaves covered with print. In the recognition of that book as So-and-so's Travels, the implied inference is, that these white leaves are covered with print of a particular size, divided into chapters with particular titles, containing paragraphs that express particular ideas. Thus the likeness of relations involved in the intuition, is both more exact and more detailed.

§ 313. The general community of nature thus shown in mental acts called by different names, may be cited as so much confirmation of the several analyses.

In preceding chapters, we saw that all orders of Reasoning —Deductive and Inductive, Necessary and Contingent, Quantitative and Qualitative, Axiomatic and Analogical— come under one general form. Here, we see both that Classification, Naming, and Recognition are nearly allied to one another, and that they, too, are severally modifications of that same fundamental intuition out of which all orders of reasoning arise. Nor are Classification and Naming allied only as being both of inferential nature ; for they are otherwise allied as different sides of the same thing. Naming presupposes Classification; and Classification cannot be carried to any extent without Naming. Similarly with Recognition and Classification, which are also otherwise allied than through their common kinship to ratiocination. They often merge into each other, either from the extreme likeness of different objects, or the changed aspect of the same object ; and while Recognition is a classing of a present impression with past impressions, Classification is a recognition of a particular object as one of a special group of objects.

This weakening of conventional distinctions—this reduction of these several operations of the mind, in common with

all those hitherto considered, to variations of one operation, is to be expected as the result of analysis. For it is a characteristic of advancing science to subordinate the distinctions which a cursory examination establishes; and to show that these pertain, not to Nature, but to our language and our system.

CHAPTER X.

THE PERCEPTION OF SPECIAL OBJECTS.

§ 314. The several mental processes treated of in the last chapter, must be glanced at under their obverse aspect. We found Classification and Recognition to be allied forms of the act by which surrounding things become known. It remains to be pointed out that surrounding things can become known only by acts of Classification or Recognition.

Every perception of an external object involves a consciousness of it as such or such—as a something more or less specific; and this implies, either the identification of it as a particular thing or the ranging of it with certain kindred things. Every complete act of perception implies an expressed or unexpressed "assertory judgment"—a predication respecting the nature of that which is perceived; and the saying what a thing *is* is the saying what it is *like* —what class it belongs to. The same object may, according as the distance or the degree of light permits, be identified as a particular negro; or more generally as a negro; or more generally still as a man; or yet more generally as some living creature; or most generally as a solid body. In each of which cases the implication is, that the present compound impression is like certain past compound impressions. When, as sometimes happens from mental distraction, we go on searching for something actually in our hands, or overlook something directly under our eyes, we get clear proof

that the mere passive reception of the group of sensations produced by an object, does not constitute a perception of it. A perception of it can arise only when the group of sensations is consciously co-ordinated and their meaning understood. And as their meaning can be understood only by help of those past experiences in which similar groups have been found to imply such and such facts, the understanding of them involves their assimilation to those groups—involves the thinking of them as like those groups, and as having like accompaniments. The perception of any object, therefore, is impossible save under the form either of Recognition or of Classification.

The only qualification of this statement that seems needed, concerns cases in which some kind of thing is seen for the first time—cases, therefore, in which a thing is known not as *like*, but as *unlike*, the things previously known. Under such conditions it appears that as there exists no previously-formed class, there is no Classification. But further consideration will show that there is a general classification, in default of a special one. Suppose the object to be an animal just discovered. Though, in the act of perception, it may not be thought of under the class mammals or the class birds, it is still thought of under the class living beings. Suppose there is doubt whether the object is animate or inanimate. It is nevertheless perceived as a solid body, and classed as such. The primary act, then, is still a cognition of likeness of a more or less general kind; though there may subsequently arise a cognition of a subordinate unlikeness to all before-known things.

Whether this law holds when we descend to the simplest kinds of cognition, it would be premature here to inquire; for at present we have to do only with those involved cognitions by which surrounding objects are severally distinguished as complex wholes. To meet all possible criticisms, however, the statement may be qualified by saying that a special perception is possible, only as an intuition of the

likeness or unlikeness of certain present attributes and relations, to certain past attributes and relations.

§ 315. As implied above, the perception by which any object is known as such or such, is always an acquired perception. All psychologists concur in the doctrine that most of the elements contained in the cognition of an observed object, are not known immediately through the senses, but are mediately known by instantaneous ratiocination. Before a visual impression can become a perception of the thing causing it, there must be added in thought those attributes of trinal extension, size, solidity, quality of surface, &c. &c., which, when united, constitute the nature of the thing as it is known to us. Though these seem to be given in the visual impression, it is demonstrable that they are not so, but have to be reached by inference. And the act of knowing them is termed acquired perception, to signify the fact that while really mediate, it appears to be immediate.

The like holds of those various actions which objects exhibit: the perceptions of them are similarly acquired, and similarly imply classification. If an adjacent person at whose back we are looking turns half round, the only thing immediately known is the sudden change in the visual impression. Standing alone this change has no meaning. It comes to have a meaning only when by accumulated experiences it is found that all such changes are accompanied by alterations in the relative positions of the parts, as ascertained by touch. We do not *see* the turning: we *infer* the turning. We conceive a certain relation between the changes we see and the motions we might feel, which is *like* numberless previously-experienced relations; we *classify* the present relation with a series of past relations; and we signify it by a word *like* the words used to signify those past relations. The visible transformation which a piece of melting lead undergoes, can convey no knowledge unless it

is already known that certain appearances always coexist with liquidity. And what seems to be a perception of the melting is, in reality, a rational interpretation of the appearances—a classing of them with the like appearances before known, and an assumption that they stand towards certain other phenomena in relations parallel to the before-known relations.

Thus the cognitions by which we guide ourselves from moment to moment, in the house and in the street, are all of them acquired perceptions; all of them involve the classification or recognition of attributes, groups of related attributes, and the relations between such groups; all of them embody inferences; all of them imply intuitions of likeness or unlikeness of relations.

§ 316. And here we see again that the divisions made among the various mental processes have merely a superficial truth. At the conclusion of Chapter VIII., Reasoning was defined as the *indirect* establishment of a definite relation between two things; in contrast to Perception, in which the relation is established *directly*. But now we find that all those perceptions by which complex objects become specifically known, also involve the indirect establishment of relations. Though on contemplating the lights and shades and perspective outlines of a building, the fact that it is a solid body seems to be immediately known, yet analysis proves that its solidity is known mediately. And this analysis is confirmed by the stereoscope, which, by simulating the evidence of solidity, induces us to conceive as solid that which is not solid. Obviously, therefore, the indirect passes into the direct by long-continued habit. Just as the meaning of a word in a new language, though at first remembered only by the intermediation of the equivalent word in a known language, by and by comes to be remembered without this intermediation; so, by constant repetition, the process of interpreting our sensations becomes so

rapid that we appear to pass directly to the facts which they imply. Still more manifest will appear the purely relative truth of this division, when it is observed that what seem unquestionably direct cognitions are united by insensible gradations with indirect ones. If I stand a hundred yards from the front of a house, the shape of that front seems to be known immediately: the relations of the parts are all directly presented to consciousness. But if I stand within a yard of the front and look up at it, the outlines, as then apparent, are not in the least like those seen from a distance; and the conception I now form of its shape must be *inferred* from the greatly distorted outlines I see. Yet between a hundred yards and one yard, there are ten thousand points from which may be had as many views, each differing inappreciably from its neighbours. Evidently, then, the transition from a *directly*-perceived shape to an *indirectly*-perceived shape is insensible. When to facts of this kind is added the fact that we often skip the intermediate steps of an habitual argument, and pass at once from the premisses to a remotely-involved conclusion—when we thus see that in conscious reasoning also, the tendency is for indirect processes to become more and more direct; we are forced to admit that it is only relatively, and not absolutely, that Reasoning is distinguished from Perception by its indirectness.

CHAPTER XI.

THE PERCEPTION OF BODY AS PRESENTING DYNAMICAL, STATICO-DYNAMICAL, AND STATICAL ATTRIBUTES.*

§ 317. The relation established between object and subject in the act of perception, is threefold. It assumes three distinct aspects, according as there is some kind of activity on the part of the object, on the part of the subject, or on the part of both. If, while the subject is passive, the object is working an effect upon it—as by radiating heat, giving off odour, or propagating sound; there results in the subject a perception of what is usually termed a secondary property of body, but what may be better termed a dynamical property. If the subject is directly acting upon the object by grasping, thrusting, pulling, or any other mechanical process, while the object is reacting, as it must, to an equivalent extent; the subject perceives those variously-

* The divisions thus designated, answer to those which Sir William Hamilton classes as Secondary, Secundo-primary, and Primary. While coinciding in the general distinctions drawn in his dissertation, I do so on other grounds than those assigned; and adopt another nomenclature for several reasons. One is that the names Primary, Secundo-primary, and Secondary, implying, as they in some degree do, a serial genesis in time, do not, as it seems to me, correspond with the true order of that genesis, subjectively considered; while, objectively considered, we cannot assign priority to any. Another is that these terms, as used by Sir William Hamilton, have direct reference to the Kantian doctrine of Space and Time, from which I dissent. And a third is that the terms above proposed are descriptive of the real distinctions among these three orders of attributes

modified kinds of resistance which have been classed as the secundo-primary properties, but which I prefer to class as statico-dynamical. And if the subject alone is active—if that which occupies consciousness is not any action or re action of the object, but something discerned *through* its actions or reactions—as size, form, or position; then the property perceived is of the kind commonly known as primary, but here named statical.

The three classes of attributes thus briefly defined, which will hereafter be successively considered at length, are usually presented to consciousness together. The space-attributes are knowable only through the medium of resistance and the other force-attributes. Tangible properties are generally perceived in connexion with form, size, and position. And of the non-tangible ones, colour is mostly associated with the surfaces of solids, and cannot be conceived apart from extension of two dimensions. An object held in the hands and regarded by the eyes, presents to consciousness all three orders of attributes at once. It is known as something resisting, rough or smooth, elastic or unelastic; as something having both visible and tangible extension, form, and size; as something whose parts reflect certain amounts and qualities of light; and, on further examination, as something specifically scented and flavoured.

In conformity with the method hitherto pursued, of setting out with the most involved combinations, resolving these into simpler ones, and these again into still simpler ones; our analysis of the perception of body will be best initiated by taking an exhaustive perception as above described, and considering what are the relations among its various elements. And to simplify the problem, it will be well to treat first of those *contingent* attributes known as secondary, and here called dynamical; so that after having analyzed these in themselves, and in their relations to the *necessary* attributes, we may deal with the perception of necessary attributes as divested of everything that is extraneous.

§ 318. Beginning with these contingent attributes as contemplated in themselves, let us first consider the propriety of classing them as dynamical.

The most familiar ones are obviously manifestations of certain forms of force. Of sound, we know that it becomes sensible to us through vibrations of the *membrana tympani*, and that these vibrations are caused by waves in the air. We know, too, that the body whence these proceed must be thrown into a vibratory state by some mechanical force; that it thereupon propagates undulations through surrounding matter; and that in this purely dynamical action consists the production of sound. Respecting heat we know that it may be generated mechanically, as by compression or friction, and that, conversely, it is itself capable of generating mechanical force. We find that in its reflections and refractions, it conforms to the law of composition of forces; and that, by the now-established undulatory theory, its multiplied phenomena are resolved into dynamical ones. Further, there is the fact that on holding a thermometer near the fire, the same agent which causes in the hand a sensation of warmth causes motion in the mercury. The phenomena of colour, again, are reducible to the same category. The reflections and refractions of light are inexplicable, save mechanically; and only on the theory of undulations can polarization, diffraction, &c., be accounted for. Light is now recognized as one form of the primordial force, which may otherwise manifest itself as sensible motion, as electricity, as heat, as chemical affinity. In the fact that great heat is accompanied by luminosity, joined to the fact that great heat may be generated mechanically, we clearly trace the transformation; while, conversely, we find light producing a dynamic effect, alike in all photographic processes and in those molecular re-arrangements which it works in certain crystals. Nor must we forget that while, under ordinary circumstances, matter only reflects and modifies the light falling upon it;

yet under fit chemical conditions, it becomes an independent source of light. Though not the immediate effects of radiant forces, odours are demonstrably dynamic in their origin. The established doctrine of evaporation implies that the giving-off of particles which produces odoriferousness, must be ascribed to molecular repulsion. Those diffused molecules constituting the scent of a body, must have been propelled from the surfaces of that body before they acted upon the nostrils; and hence it follows that a certain form of activity in the object, is the efficient cause of a sensation of smell in the subject. The only secondary attribute not obviously dynamic is that of taste. But the close alliance existing between taste and smell is almost of itself sufficient to prove that if one is dynamic so is the other. When we bear in mind that for a body to have any gustable property implies some degree of solubility in the saliva, without which its particles cannot be carried by endosmose through the mucous membrane of the tongue, and cannot therefore be tasted; and when we further bear in mind that the diffusion of particles through liquid is analogous to their diffusion through air, and that the molecular repulsion causing the last has its share in the first; we shall see further reason to consider the sensation of taste as due to an objective activity.

But the dynamic nature of the secondary attributes is most clearly seen when, instead of contemplating the object as acting, we contemplate the subject as acted upon. All can testify that the flavours of certain drugs are so persistent as to continue to give feelings of disgust, long after the drugs themselves have been swallowed. A pungent odour causes a sneeze; and the smell from a slaughterhouse or boneyard creates a nausea which so tyrannizes over consciousness, as to exclude every thought but that of escape. A flash of lightning, or any sudden change in the amount or quality of the light surrounding us, instantly changes the currents of our thoughts. And still more significant is the

fact that a strong glare abruptly thrown on his face, will often awaken a sleepy person. Similarly with changes of temperature. Any one standing with his hands behind him cannot have a red-hot iron put close to them without his ideas being at once directed into a new channel; and if the degree of heat passes a certain point, he will draw away his hands automatically. So, too, is it with sounds. They may create either pleasurable or painful states of consciousness. They often distract the attention against the will. When loud, they cause involuntary starts in those who are awake; and either waken those who sleep, or modify their dreams. If, then, in these extreme cases, the so-called secondary attributes of body are unquestionably dynamic, they must be so throughout. If we find the eyes made to water by mustard taken in excess; vomiting excited when squeamish by the smell of a steamer's cabin; a blinking of the eyes, and a painful sense of dazzling, caused by looking at the sun; a scream called forth by a scald or burn; an involuntary bound produced by an adjacent explosion; it becomes an unavoidable conclusion that those properties of things which we know as tastes, scents, colours, heats, sounds, are effects wrought on us by forces in the environment. The subject undergoes a change of state determined by some external agency, directly or indirectly proceeding from an object. Though there may arise in him, during the interpretation of its outward cause, various internally-determined states; yet, in so far as the change itself is concerned, he is simply recipient of an objective influence. In respect to all these so-called secondary attributes, the object is *active* and the subject is *passive*.

Let us next observe that, with the exception of taste which is in some respects transitional, these dynamical attributes are those by which objects act upon us through space. By means of the light it radiates or reflects, an outward thing renders itself visible when afar off. At

various degrees of remoteness, objects in states of sonorous vibration arrest our attention. We are made aware of the presence of odoriferous substances while only in their neighbourhood. Masses of hot matter affect us when near to them. Unlike hardness, softness, flexibility, brittleness, and all the statico-dynamical attributes, which are cognizable by us only through actual contact, either immediate or mediate; unlike the statical attributes, shape, size, and position, which do not in themselves affect us at all, but become known only by acts of constructive intelligence; these dynamical attributes modify consciousness at all distances, from that of a star downwards. Eyes, ears, nose, and the diffused nervous agency through which temperature is appreciated, are inlets to the influences of objects more or less distant; and the ability that distant objects have thus to work changes in us, again exhibits their inherent activity.

These attributes are further distinguished by the peculiarity that they are, in a sense, separable from what we commonly call body. Light in varying intensities is known as pervading surrounding space. The many tints assumed by the sky are not, in so far as our senses are concerned, the attributes of matter. And by casting the prismatic spectrum on a succession of surfaces, or by observing how the iris in the spray of a cascade moves with every change in the position of the eye, proof is gained that colour, in its various qualities, is not an inherent property. The like holds with respect to the relation between sounds and vibrating objects; which we learn only by a generalization of experiences. To the incipient intelligence of an infant, noise does not involve any conception of body. In an oft-recurring echo, the sound has come to have an existence separate from the original concussion—continues after the vibrating body which caused it has become still. We frequently hear sounds produced by things that are neither visible nor tangible to us, but are simply inferred. And

by the phrase,—"What's that?" commonly uttered on hearing an unusual noise, it is clearly implied that the noise has been identified as such before any object has been thought of as causing it. Odours, again, are often perceived when wafted far from the substances diffusing them. A room scented by something placed in it, may retain the scent long after the thing has been removed. We may be strongly affected by an entirely new smell while ignorant what produces it, or from which side it comes. Similarly with heat. In a cloudy summer we often feel marked changes of temperature that are not traceable to any special object. The warmth of a room heated by hot-water pipes may be felt for some time before it is discovered whence the warmth proceeds. So even is it with gustable properties. Though ordinarily the things which we taste are simultaneously known to us as fluid or solid matters, yet it needs but to remember the persistence of disagreeable flavours, even after the mouth has been rinsed, to perceive that sapidity can be dissociated from body: understanding by the word body, something perceivable as extended and resisting. Here again, then, the dynamical attributes stand apart from the statico-dynamical and statical ones; for none of those modifications of resistance constituting the one class, nor those tangibly-perceived modes of extension constituting the other (visible extension being but symbolical of tangible extension), can be recognized apart from the objects to which they belong.

Note, again, that these dynamical or secondary attributes are incidental. Different bodies exhibit them in countless degrees and combinations; and each body exhibits them more or less, or not at all, according as surrounding conditions determine. In the dark, things are all of them colourless. In the light, their appearances vary as the light varies in kind and degree. The colour of a dove's neck changes with the position of the observer's eye;

while that of some crystals and fluids is reversed when the light is transmitted instead of being reflected. Under ordinary circumstances most objects are silent. Those that emit sound do so only under special influences; and the sound that any one of them emits is in great measure determined by the nature or intensity of the influences. A great number of substances are inodorous; and of the rest, the majority cannot be perceived to have any smell unless held close to the nostrils. Things that are almost scentless at low temperatures may become strongly scented at high ones. Very many bodies have no taste whatever; and the sapid qualities of others vary according as they are hot or cold. The temperature of the same mass may be such as to give a sensation of greater or less heat; or such as to give no appreciable sensation at all; or such as to give a sensation of greater or less cold. Thus the incidental character of these attributes is manifest. To a person specially circumstanced, an object may be at once colourless, soundless, scentless, tasteless, and of such temperature as to produce no thermal effect upon him; or the object and the circumstances may be such that he shall be variously affected by one, or two, or three, of these dynamical attributes. But it is otherwise with the statico-dynamical and statical attributes. For while different bodies present different amounts of resistance and extension; and while in the same body the resistance and extension admit of more or less variation; there is no body *without* resistance and extension.

Lastly, let it be noticed that these so-called secondary attributes of body, which we find distinguishable from the rest as being dynamical, as acting through space, as cognizable apart from body, and as manifested by body only incidentally, are not, in any strict sense, attributes of body at all. I do not mean simply that, being dissociable from body, body can readily enough be conceived without them; nor do I mean that what we call colour, sound, and the rest

are subjective effects produced by unknown powers in the objects; but I mean that these unknown powers are literally not in the objects at all. Rightly understood, the so-called secondary attributes are manifestations of certain forces which pervade the Universe; and which, when they act upon bodies, call forth from them certain reactions. On being struck, a gong vibrates; and by communicating its vibrations to the air, or any intermediate substance, affects an auditor with a sensation of sound. What is the active cause of that sensation? It is not the gong: it is the force which, being impressed on the gong, is changed by its reaction into another shape. When the Sun shines on any mass of matter, some of his rays are absorbed while some are reflected. In most cases the light being decomposed, its reflected portion affects us as colour; and by special masses of matter it is refracted and dispersed in chromatic bands. That is, a certain force emanating from the Sun impresses itself on matter, and is, by the counter-action of matter, more or less metamorphosed. The heat given off by burning coal, and by a briskly-hammered piece of iron, are reactions called forth, in the first case by the chemical action of the surrounding oxygen, in the second by mechanical pressure. The molecular repulsion whence odoriferousness results, is one of the reactions consequent on the reception of heat—is known to vary as the heat varies; and could heat be entirely withheld, odours would cease. Throughout, therefore, these attributes are, if considered in their origin, activities pervading space; and can be ascribed to body only in the sense that body when exposed to them, reacts upon them, modifies them, and is known to us through the modifications. Strictly speaking, one of these simple sensations of colour, sound, scent, &c., involves a series of actions and reactions of which the object proximately yielding it manifests but the last. The light, or mechanical force, or heat, serving as its conspicuous cause, itself resulted from pre

vious actions and reactions, which lead us back into an indefinite past filled with changes. But confining our attention to the elements with which we have immediately to deal, we see that rightly to understand one of these dynamic attributes, implies the contemplation of three things:—First, a force, either diffused as light and heat or concentrated as momentum; second, an object on which some of that force is impressed, and which in so far as it is a recipient of force is passive, but in so far as it reacts and determines that force into new forms and directions is active; and third, a subject on whom some of the transformed force expends itself in producing what we term a sensation, and who as the recipient of this transformed force is passive, but who may be rendered active by it.

Literally, then, the so-called secondary attributes are neither objective nor subjective; but are the triple products of the subject, the object, and the environing activities. Sound, colour, heat, odour, and taste, can be called attributes of body only in the sense that they imply in body certain powers of reaction, which appropriate external actions call forth. These powers of reaction, however, are neither the attributes made known to us as sensations, nor those vibrations or undulations or molecular repulsions in which, as objectively considered, these attributes are commonly said to consist; but they are the occult properties in virtue of which body modifies the forces brought to bear upon it. Nevertheless, it remains true that these attributes, as manifested to us, are dynamical. And in so far as the immediate relation is concerned, it remains true that in respect of these attributes the object is active and the subject is passive.

§ 319. Let us now proceed to define the perception which we have of a body presenting these non-necessary attributes, in conjunction with the necessary attributes; that is—a body as ordinarily perceived.

On taking up and contemplating an apple, there arises in

consciousness, partly by presentation through the senses and partly by representation through the memory, what seems to be one state, but what analysis proves to be a very complex combination of many states. The greater number of these remain to be considered analytically in subsequent chapters, and can here be simply enumerated. Among them we have, first, the coexistence in time of the contemplating subject and the contemplated object. Further we have that relative position of the two in space which we call proximity. We have also that group of impressions on the finger-ends, which leads us to conceive the object as not only having a position in space but as occupying space, and a certain limited amount of space. Yet again we have that more involved series of tactual and motor impressions gained by moving the fingers about it, and constituting our notion of its tangible shape. To these must be added that supplementary set of impressions by which we recognize its surface as smooth; and that other set by which we form an idea of its hardness. Passing from these fundamental data acquired through the tactual and muscular senses, we have to note the impressions through which the apple's coexistence in time and adjacency in space are visually as well as tactually known. With these we must join the impressions which make up our conception of its visible bulk and figure. And we must not omit those which indicate to us a correspondence between the data received through the eyes and those received through the fingers. But now, along with the statical and statico-dynamical attributes primarily known through combined sensations of resistance and motion, and some of them re-known through combined ocular sensations of light, shade, and focal adjustment, we find certain other attributes standing in various orders of relation. Joined with the attributes of position, size, and form, as visually perceived, is the attribute of colour (including in the word all possible modifications of light), recognized as coexistent in time and coin-

cident in space with these statical attributes. This relation admits of some variation, however. For though, when our consciousness of colour entirely ceases, our consciousness of visible form, size, and place, ceases with it; yet by alterations in the amount and quality of the light, our impression of colour may be variously changed without any change being produced in our consciousness of form, size, and place. While it is generically absolute this connexion is specifically conditional. Note this, however, that the relation of coincidence in time and space between the several impressions we have of the visible attributes and those we have of the tangible ones, is entirely conditional. It depends on the presence of light; on the opening of the eyes; and on the object being within the field of view. Unless each of these three conditions is fulfilled, no relation of coincidence in time and space between these two sets of attributes can be established. Similarly with the odour. This, being but weak, can be perceived to accompany the other attributes only when the apple is placed near the nostrils and air drawn in. The presence of a certain taste is in like manner unknowable, save through actions similarly special. Thus, the common characteristic of the dynamical attributes, is the extreme conditionality of their coexistence with the statico-dynamical and statical ones, in so far as our consciousness is concerned. Though our perceptions of the softness, roughness, flexibility, &c., of any body examined by the fingers, are conditional on our performance of certain manipulations as well as on the nature of the body; yet the general perception of resistance is wholly unconditional. Though our perceptions of the specific extension of the body—its size and shape—are similarly conditional on its character and on our acts; yet the general perception of extension is wholly unconditional. *Some* resistance and *some* extension are the invariable and necessary elements of the cognition. Be the body what it may, and be the part of the skin touched by the body what it may, if it is perceived at all, it is perceived as something

resisting and extended. But the perception of the dynamical attributes as coexistent with the rest, depends not only on the nature of the object and on our acts, but also on the exposure of the object to certain agencies pervading the environment.

Here, then, is the general result. Any total perception, uniting the three orders of attributes in one cognition, is a state of consciousness formed thus:—Along with certain general impressions of resistance and extension, *unconditionally* standing to each other and the subject in relations of co-existence in time and adjacency in space; and along with certain specialized impressions of resistance and specialized impressions of extension, *conditionally* standing to each other and the subject in similar space-relations and slightly-modified time-relations; there are certain impressions of a different order standing in a *doubly conditional* manner to the previous ones, to the subject, and to one another, in space and time relations still further modified. This definition must not, however, be taken as exhaustive; for nothing is said of all the inferred facts bound up with the perceived facts—nothing of those many minor conditions and accompaniments, only to be described at the cost of pages. It is intended simply to exhibit, in as precise a way as the present stage of the analysis admits, the general mode in which our cognitions of the several orders of attributes are united in ordinary perception—simply to display the relationship in which, as known to us, the dynamical attributes of body stand to its other attributes; so that having duly contemplated this relationship, we may go on to analyze the perception of the statico-dynamical and statical attributes by themselves.

§ 320. The mental act effecting one of these perceptions next claims our attention. So far, we have considered only the several elements which compose the perception; and there has yet to be considered the process by

which they are co-ordinated. This is what may be termed a process of *organic classification.*

As explained in preceding chapters, the "assertory judgment" involved in every perception of an object, is an act of either classification or recognition. According as it is more or less specific, a perception involves the thought—"This is a dog;" or, "This is something alive;" or, "This is a solid body." It is not requisite that the assertory judgment should be verbally expressed, either outwardly or inwardly; but that the perceived object must be more or less consciously referred to its class, is manifest from the fact that when, after some ordinary thing has been put under his eyes a person cannot tell what the thing was, we say that he did not perceive it. Though the needful impressions were made on his senses, he did not so attend to them as to become conscious of their import. Had he done so, his subsequent ability to name the thing would imply that he had recognized its nature; that is, its class. Now this semi-conscious classification which every complete perception of an object involves, *is necessarily preceded by a still less conscious classification of its constituent attributes, of the relations in which they stand to one another, and of the conditions under which such attributes and relations become known.* At first sight, this seems an incredible proposition—incredible both as asserting what self-analysis gives no evidence of, and as implying a mental activity inconceivably great. Nevertheless, inquiry will show that, *à priori,* the perception of an object is not otherwise possible, and also that direct experience, not less than analogy, implies the performance of some such spontaneous assimilation.

Observe first the necessities of the case. If, instead of that which I perceive to be an apple, there had been presented something having like form and colours but measuring a yard in diameter, I should not have concluded it to be an apple. Or if, while the bulk and colours were as usual,

the form had been cubical or pyramidal, I should have regarded it as something else than an apple. And similarly if, though like in other respects, it had been sky-blue, or covered with spines, or as heavy as lead. What now is implied? Clearly this, that before the object is recognized as an apple, each of the chief constituent attributes is recognized as *like* the homologous attribute in other apples. The bulk is perceived to be like the bulk of apples in general; the form like their forms; the colour like their colours; the surface like their surfaces; and so on. The elements constituting the total perception, are severally classed with the before-known like elements; just as the entire group is afterwards classed with the before-known like groups. Moreover, there is a classing not only of the constituent attributes but of their relations. If the apple be one marked with streaks of red, then these must run in certain directions. Were they to run equatorially, it would be at once decided that the object was not an apple; as also, if the stem and the remnant of the calyx did not stand towards each other in specific positions. That is, the relations of coexistence and proximity and arrangement subsisting among the constituent attributes, must also be recognized as like certain before-known relations—must be classed with them. Further, there must be classed the conditions under which the attributes and relations become known. The colours and visible form of an apple being perceivable only during the presence of light, it results that a consciousness of light, regarded as a condition like the before-known conditions, becomes an indirect component of the perception: to prove which, it needs but remember that the form and colours of an apple if seen in the dark, would be regarded not as implying an apple but as implying an optical illusion. Its weight, again, is perceived as coexistent with its tangible properties; but only when it is lifted. No sensation of weight, save one obtained under this condition like certain remembered conditions, could be ascribed

to the apple, or become an element in the perception of it. Thus, then, there is a classing of the several attributes with the like before-known attributes, of the relations subsisting among them with like before-known relations, and of the conditions under which they are perceived with like before-known conditions. And the classification of the object as an apple is the cumulative result of these constituent classifications.

"Can such a complicated set of mental acts be performed so rapidly as to leave no trace in consciousness?" The question is pertinent. I have already, by the phrase "*organic* classification," indicated what I conceive to be the solution of this difficulty; and it needs but to note the stages through which our acts of classing pass from the conscious to the unconscious, to see that the facts point to this solution. Let any one walking through the Zoological Gardens, meet with an animal he has read about but has not before seen. How does he endeavour to determine its kind? He considers its separate characteristics—observes successively its size, its general shape, its head, its feet, its tail, its hair, its colour—classes these respectively as large, as broad, as pointed, and so forth—does in a less definite way what a zoologist in a parallel case does systematically; and if he succeeds in classing the creature, he succeeds by thus thinking of the likenesses of its constituent attributes and their relations to those of creatures he has heard of, read of, or seen drawings of. Let him pass on to some beast before seen but not familiar, as the sea-bear. His first sight of it is accompanied by a distinct act of classing, and by a repetition of the name, either aloud or to himself. Let him walk by cages having inmates he has often watched, as the lions, and the act of classing will obtrude upon his consciousness much less distinctly. Now let him leave the gardens. On passing the horses standing at the gates, he will be conscious that they are horses; but he will not specifically identify them as such in deliberate acts of thought.

And when he reaches the streets, though each of the hundred individuals passing him every minute is distinguished as man, woman, boy, or girl—is classed, that is—the mental act is performed so rapidly as scarcely to interrupt the current of his thoughts. Now this ever-increasing facility and quickness in classing complex groups of attributes, implies an ever-increasing facility and quickness in that classing of the attributes themselves, their relations, and the conditions under which they are perceived, that begins with infancy. Forms, sizes, distances, colours, weights, smells, and the rest, though once consciously classed, gradually during childhood come to be classed less and less consciously; and this classification being simpler than any other, beginning earlier and being almost infinitely repeated, grows more rapid than any other: eventually becoming practically automatic.

To verify this interpretation it needs but to remind the reader that he has, within his own experience, a case in which the entire progress from conscious to unconscious classification is traceable. When learning to read, the child has to class each letter by a distinct mental act. This symbol A, has to be thought of as like certain others before seen, and as standing for a sound like certain sounds before heard. By practice these processes become more and more abbreviated, or less and less conscious. Presently the power is reached of classing by one act a whole group of such symbols—a word; and eventually an entire cluster of words is recognized instantaneously. Now, were it not that these steps can be recalled, it would seem absurd to say that when the reader takes in at a glance the sentence —"This is true," he not only classifies each word with the before-known like words, but each letter with the before-known like letters. Yet, as it is, he will see this to be an unavoidable inference. He knows that such acts of classing were performed at first; and as no time can be named at which they were given up, it follows that the

entire change has arisen from a progressive increase of rapidity, which has finally made them almost automatic. And if this has taken place with acts of classing commenced so late as five or six years old, still more must it have taken place with those simpler acts commenced at birth.

The foregoing definition of the perception of body as presenting the three orders of attributes, therefore requires to be supplemented by this explanation; that the several attributes, the relations in which they stand to one another and to the subject, as well as the conditions under which only such attributes and relations are perceived, have to be thought of as like before-known attributes, before-known relations, and before-known conditions.

CHAPTER XII.

THE PERCEPTION OF BODY AS PRESENTING STATICO-DYNAMICAL AND STATICAL ATTRIBUTES.

§ 321. If we imagine a human being without sight, hearing, taste, smell, or the sense of temperature; then the only attributes of body cognizable by him, will be the statico-dynamical and the statical. All the knowledge he can gain by touching, pressing, pulling, and rubbing things, as well as by moving his limbs, or body, or both, in contact with them, comes under these heads: the one comprehending knowledge which implies an activity on his part, and a re-activity on the part of the things; the other comprehending knowledge which implies his independent internal activity in putting together certain of the impressions he has received.

These statico-dynamical and statical attributes are usually presented to consciousness closely united. When in the dark any object is examined by the hands, more or less definite perceptions of its softness, smoothness, elasticity, &c., are joined with more or less definite perceptions of its position, size, and form. These two classes of perceptions may accompany each other with various degrees of incompleteness; but *some* connexion between them is invariable. As will hereafter be shown, it is questionable whether primordially they exist in this relation; but without doubt by the adult human consciousness, all tactile resistances are uncondi

tionally known as coexistent with *some* extension, and all tactile extensions are unconditionally known as coexistent with *some* resistance.

In pursuance of the method hitherto followed, we have now to analyze one of these complex tactual perceptions in its totality. As in the last chapter we attended mainly to the contingent attributes and their relations to these essential ones, with a view of afterwards leaving the contingent out of consideration; so here, it will be best to treat more especially of the resistance-attributes, so that having observed how we perceive them and their relations to the extension-attributes, we may proceed to deal with the extension-attributes by themselves.

§ 322. Note first why these resistance-attributes which have been termed secundo-primary, may be more appropriately termed statico-dynamical.

They are all of them known as manifestations of mechanical force. They are all results of attraction, of repulsion, and of that property in virtue of which a body's reaction upon a disturbing agent varies as the quantity of motion which that disturbing agent impresses upon it.* They are the attributes of body involved alike in its standing and in its acting. That capacity which matter has of passively retaining, while undisturbed, its size, figure, and position, may rightly be regarded as statical; while that

* I use this awkward circumlocution to avoid an inaccuracy. Among the sources, physically considered, of the secundo-primary attributes, Sir William Hamilton enumerates *inertia*. But inertia is not a force: it is simply the negation of activity. It is not a positive attribute: it is a purely negative one. There is a very general belief that matter offers some absolute opposition to anything tending to displace it. This is not the fact. Take away all extrinsic hindrance—all friction, all resisting medium—and an infinitesimal force will produce motion; only the motion will be infinitesimal, in consequence of the law that the velocity varies as the momentum (or force impressed) divided by the mass. Were inertia a force, all the calculations of astronomers respecting planetary perturbations and the like, would be erroneous. The term *vis inertiæ* is a misnomer.

capacity which it has of meeting by a proportionate counteracting force, any force brought to bear upon it, must be considered as dynamical; and the fact that these capacities cannot be dissociated, but are two sides of the same capacity, is expressed by uniting the descriptive terms. Add to this, that if we class those attributes in respect of which the object is active while the subject is passive, as dynamical; and if we class as statical those in respect of which the subject is active while the object is passive; then we must class as statico-dynamical those in respect of which subject and object are both active.

Attributes of this class are more numerous than would be supposed. The resistances offered by objects to forces tending to raise them—their weights—originate only the attributes of *Heavy* and *Light;* which indicate amounts of gravitative force in relation to bulk. But the opposition which objects offer to compression or tension, is distinguishable not only in its relative amounts but in its kinds. Of bodies that resist in different modes as well as in different degrees, we have the *Hard* and *Soft;* the *Firm* and *Fluid;* the *Viscid* and *Friable;* the *Tough* and *Brittle;* the *Rigid* and *Flexible;* the *Fissile* and *Infissile;* the *Ductile* and *Inductile;* the *Retractile* and *Irretractile;* the *Compressible* and *Incompressible;* the *Resilient* and *Irresilient;* and (combined with figure) the *Rough* and *Smooth*.* Of these

* With some exceptions this is Sir William Hamilton's classification. I do not, however, separate, as he attempts to do, the attributes which (physically considered) imply molecular attraction (as the Retractile) from those which imply molecular repulsion (as the Resilient); because, in reality, all of them imply both. As there is a balance of the molecular attractions and repulsions in an undisturbed body, a body cannot have any of its molecules disturbed by an external force without both the attractive and repulsive forces coming into active opposition. On examining the fracture of a piece of wood broken transversely, part of the area will be seen to exhibit marks of tension and part of compression; and the line dividing these parts is called the "neutral axis." A body cannot exhibit ductility or retractility without being partially thrown into a state of compression; seeing that the extending force cannot be applied to the body without compressing it somewhere.

pairs of attributed qualities, several are purely relative—are simply degrees of the same. This is manifestly the case with *Hard* and *Soft*, *Firm* and *Fluid*, *Compressible* and *Incompressible*. But there are some, as *Ductile* and *Inductile*, which are not united by insensible gradations.

§ 323. Before defining our perceptions of these attributes, it is requisite that we should consider the several distinct sensations resulting from the direct actions of body upon us; together with those which accompany our direct actions upon body. There are two in respect of which body is active while we are passive, and two in respect of which we are active while body is passive. Those which we may class as of objective origin, are the sensations of *touch* and *pressure*. Those which originate subjectively are the sensations of *muscular tension* and *muscular motion*. Let us consider them seriatim.

When one of the fingers is brought gently in contact with anything, when a fly settles on the forehead, or when a hair gets into the mouth, there arises the sensation of *touch proper*. This sensation is undecomposable—is not accompanied by any sensation of pressure; and though we always ascribe it to some resisting object, we cannot say that the resistance is given in the sensation. That the sensation is caused by mechanical force, we know; but we know this mediately. Mechanical force is immediately knowable by us only as that which opposes muscular action; and as, in this case, muscular action is not called forth, mechanical force can only be inferred.

If the hand be opened out on the table and a weight be placed on one of the fingers, there results the sensation of *pressure*, which is clearly distinguishable from the last. In most of our tactual impressions the two are so mixed as to be not easily discriminated. But if we compare the feeling caused by a fly on the forehead, with that caused by a weight on the finger, we shall perceive that no increase in

the intensity of either will produce the other. That the two differ not in degree but in kind, will be yet more clearly seen on remembering that the sensation of tickling, which a continuity of touch proper produces, is the strongest when the touch is extremely light; and that when the touch becomes heavy the sensation of tickling ceases. Contrasting them physiologically, we may presume that the sensation of touch proper results from a stimulation of nerves in the skin, while that of pressure results from a stimulation of nerves in the subjacent tissues; that hence, by very gentle contact the nerves in the skin alone are affected, while by rougher contact the nerves in both are affected; that consequently, in passing from gentle to rough contact by degrees, the single feeling at first experienced becomes masked by another feeling that arises gradually; and that thus is produced the habitual confusion of the two. It remains to be noticed that the sensation of pressure, though often associated with that of muscular tension, often exists apart from it; as in the example above given, and as in the ever-present experience of the reactive pressure of whatever surface supports the body.

The sensation of *muscular tension* also, is capable of existing separately. On holding out the arm horizontally, and still more on dealing similarly with the leg, a sensation is felt which, tolerably strong as it is at the outset, presently becomes unbearable. If the limb be uncovered and kept from contact with anything, this sensation is associated with no other.

Allied to the sensation accompanying tension of the muscles, is that accompanying the act of contracting them —the sensation of *muscular motion*. Concerning the state of consciousness induced by muscular motion, and concerning the ideas of Space and Time which are connected with it in adult minds, something will be said hereafter. For present purposes it will suffice to notice the peculiarity of this sensation. While from a muscle at rest no sensation arises;

while from a muscle in a state of continuous strain there arises a continuous sensation which remains uniform for some time; from a muscle that is contracting or relaxing there arises a sensation which is undergoing increase or decrease.

The several sensations thus distinguished, and more particularly the last three, are those which, by their combinations in various degrees and relations, constitute our perceptions of the statico-dynamical attributes of body. Let us consider some of the perceptions thus constituted.

§ 324. When we express our immediate experiences of a body by saying that it is *hard*, what are the experiences implied? First, a sensation of pressure of considerable intensity is implied; and if, as in most cases, this sensation of pressure is given to a finger voluntarily thrust against the object, then there is simultaneously felt a correspondingly-strong sensation of muscular tension. But this is not all. Feelings of pressure and muscular tension may be given by bodies which we call soft, provided the compressing finger follows the surface as fast as it gives way. In what then consists the difference between the perceptions? In this; that whereas when a soft body is pressed with increasing force, the sensations of pressure and muscular tension, while they increase synchronously, are necessarily accompanied by certain sensations of muscular movement; when a hard body is pressed with increasing force, these sensations of increasing pressure and tension are *not* necessarily accompanied by sensations of muscular movement—not, at least, by any that are appreciable. Considered by itself, then, the perception of softness may be defined as the establishment in consciousness of a relation of simultaneity between three series of sensations—a series of increasing sensations of pressure; a series of increasing sensations of tension; and a series of sensations of motion. And the perception of hardness is the same, with omission of the last

series. As, however, hardness and softness are names for different degrees of the same attribute, these definitions must be understood in a relative sense.

Take again the attribute of *resilience*, as displayed in such a body as caoutchouc. The perception of it manifestly includes as one component, the perception of softness; but it includes something more. When the finger is thrust against some soft but irresilient body, as wet clay, the three concurrent series of sensations of pressure, tension, and motion, are followed (on the withdrawal of the finger) by sensations of motion only; but when it is thrust against a piece of caoutchouc, these three concurrent series of sensations are followed by three other series in the reverse order. Following the finger, the withdrawal of which implies serial sensations of muscular motion, the caoutchouc gives a decreasing series of sensations of pressure, and a decreasing series of sensations of that muscular tension implied by the pressure. Thus the perception of resilience is definable as the establishment in consciousness, of a relation of sequence between the group of co-ordinated sensations constituting the perception of softness, and a certain other group of co-ordinated sensations similar in kind but opposite in serial order.

The perceptions of *roughness* and *smoothness* refer not to the degree or kind of cohesion subsisting among the particles of a body, but to the quality of its surface; and hence have little in common with the foregoing. The motion by which either of them is gained, is not in the line of pressure but at right angles to it. The accompanying sensations, partly of pressure, partly of touch proper, do not form an increasing or a decreasing series; but are either uniform (as when smoothness is perceived) or irregularly varied (as when roughness is perceived). The perception of smoothness, then, consists in the establishment in consciousness of a relation of simultaneity between a special series of sensations of motion, and a uniform sensation of touch proper, or pressure,

or both. While in the perception of roughness, the like sensations of motion are known as simultaneous with a broken series of sensations of touch, or pressure, or both.

It is unnecessary thus to analyze our perceptions of all the statico-dynamical attributes above enumerated. What has been said renders it sufficiently manifest, that they severally consist in the establishment of relations of simultaneity and sequence among our sensations of touch, pressure, tension and motion; experienced as increasing, decreasing, or uniform; and combined in various modes and degrees. This is all which it here concerns us to know.

§ 325. Passing from these preliminary analyses to the general subject of the chapter—the perception of body as presenting statico-dynamical and statical attributes, we find that it is made up of the following elements. The relations of coexistence in time and adjacency in space between subject and object; the combined impressions which make up our ideas of a more or less specific size and a more or less specific shape; the further impressions included in our notions of surface; those included in our notions of texture; and those many others signified by the terms ductility, elasticity, flexibility, &c.: all of them referred to a place in space that is approximately the same, and to a time that is common to them all.

Merely re-stating these several constituents of the perception, which were to some extent incidentally described in the last chapter, it remains to specify more definitely than before, the kind of union subsisting among them. When in the dark the presence of some object is revealed by accidental collision, we have, along with certain unexpected sensations of pressure and muscular tension, a vague conception of a something extended; and, as previously explained, this relation of coexistence between resistance and extension is unconditional—is independent alike of the will of the subject and the quality of the object. The

special elements of the perception are conditional. If the nature of the object is to be ascertained, its reactions must be called forth by certain appropriate actions of the subject. The sensations it gives us must become known as sequent to certain sensations we give ourselves. There must be particular kinds of volition and the particular changes of internal state that follow them, before the changes resulting from external impressions can be received. It is true that some of the resistance-attributes, as hardness and softness, usually become involuntarily known in the act of collision; though this is not necessary, since, when moving with out-stretched hands, the gentlest touch suffices to prove the existence of *something*, before yet we can know aught of its nature. But to determine whether the body is rough or smooth, flexible or rigid, ductile or inductile, implies correlative subjective activities of a complicated kind; and the modifications of consciousness accompanying these, must become essential elements of the perceptions. Hence, a statico-dynamical attribute is perceived through a union of internally-determined impressions with externally-determined impressions; which combined group of impressions is known as the consequent of those internally-determined changes constituting volition.

Defined in its totality, then, the perception of body as presenting statico-dynamical and statical attributes, is a state of consciousness having for its primary elements the impressions of resistance and extension *unconditionally* united with each other and the subject in relations of coincidence in time and adjacency in space; having for its secondary elements the impressions of touch, pressure, tension, and motion, variously united with one another in relations of simultaneity and sequence, that are severally *conditional* on the nature of the object and the acts of the subject, and all of them *conditionally* united with the primary elements by relations of sequence; and having for its further secondary elements certain yet undefined relations

(constituting the cognitions of size and form, hereafter to be analyzed), which are also *conditionally* united alike with the primary elements and the other secondary elements.

Such being the *constituents* of the perception, the *act* of perception consists in the classing these constituents, each with others of its own order. As shown in the last chapter, no one of them can be known for what it is, without being assimilated to the before-known ones which it resembles. And from the classing of each impression with like remembered impressions, each relation with like remembered relations, and each condition with like remembered conditions, results that classing of the object in its totality which is synonymous with a perception of it.

CHAPTER XIII.

THE PERCEPTION OF BODY AS PRESENTING STATICAL ATTRIBUTES.

§ 326. From that class of attributes known to us solely through one or other kind of objective activity; and from that further class known to us through some objective re-activity called forth by a subjective activity; we now pass to that remaining class known to us through a subjective activity only.

In respect of its space-attributes—Bulk, Figure, and Position—body is altogether passive; and the perception of them is wholly due to certain mental operations. Unlike heat, sound, odour, &c., which are presented to consciousness by no acts of our own, but often in spite of our acts—unlike roughness, softness, pliability, &c., of which we become conscious by the union of our own acts with the acts of things; extension under its several modes is cognizable through a wholly-internal co-ordination of impressions: a process in which the extended object has no share. Though the data through which its extension is known, are supplied by the object; yet, as those data are not the extension, and as until they are combined in thought the extension is unknown, it follows that extension is an attribute with which body does not impress us, but which we discover through certain of its other attributes. To an uncritical observer, the visible form of an object seems as much thrust upon his

consciousness by the object itself, as its colour is. But on remembering that the visible form is revealed to him only through certain modifications of light; that these modifications are produced not by the form, but by certain occult properties of the substance having the form; and that if the body had no power of reacting on light, the form would be invisible; it will be seen that the form is known not immediately but mediately. When it is further remembered that in the dark the shape and size of anything are knowable only through tactual and muscular sensations gained by acts of exploration; and that consciousness of the shape and size depends on the thinking of these in certain relations; it will no longer be questioned that in the perception of the space-attributes, the object is wholly passive while the subject is active.

The propriety of distinguishing Bulk, Figure, and Position as statical attributes, may perhaps be questioned. In mechanics, statics and dynamics are allied to one another as closely as the circle is allied to the ellipse, into which it passes by insensible steps; whereas the attributes that are here classed as statical, differ wholly and irreconcilably from those classed as dynamical. The reply is that the terms as now used are to be understood, not in the mechanical sense, but in a more general sense. Statical attributes are those which pertain to body as standing or existing. Dynamical ones are those which pertain to it as acting. If it be admitted that the so-called secondary attributes of body, which, as we find, imply its activity, are rightly termed dynamical; it must be admitted that the so-called primary ones, which, as implying passivity, are their antitheses, may be properly distinguished as statical.

§ 327. Whether the space-attributes of body are any of them knowable through the eyes alone, has been a disputed question. That our perceptions of distance are not originally visual, but result from muscular experiences, which

visual experiences serve to symbolize, is admitted. And that at least one out of the three dimensions of body, involving as it does the idea of greater or less remoteness from us, can be known only through muscular experiences, must also be admitted. But our inability to conceive of colour save as having extension of two dimensions, seems to imply that superficial magnitude is, to a certain extent, knowable by sight. Though it is manifest that superficial magnitude as known by sight is purely relative—that the same surface, according as it is placed close to the eye or a mile off, may occupy the whole field of view, or but an inappreciable portion of it; yet as, while an object is visible at all, it must present *some* length and breadth, it may be argued that superficial extension *in the abstract,* is originally perceivable through the eyes, as much as colour is. This conclusion is in one sense true and in another sense untrue. The relation between its untruth and its truth will be best seen by considering first a criticism upon it and then the reply.

Along with the conception of visible superficial extension there goes a conception of distance. Imagine a surface a foot square to be placed a yard from the eye, at right angles to the axis of vision; and imagine that four straight lines are drawn from its angles to the centre of the eye. Suppose now that a surface of six inches square be interposed at half the distance, so as to subtend to the eye the same apparent area; and that another of three inches square be interposed between this and the eye in the same manner; and so on continuously. It is manifest that were it possible to repeat this process *ad infinitum,* the area subtended by the four converging lines would disappear at the same moment that the distance from the point of convergence disappeared; and that hence, all our experiences conforming as they must to the laws of convergent rays, we can have no conception of a visible superficies without an accompanying conception of a distance between that superficies and the sentient

surface. Consequently, if distance is not conceived *à priori*, area is not conceived *à priori*. To this the reply is, that there can be no such series of diminishing areas subtending the same angular space. The argument ignores the structure of the eye; and supposes vision to continue under conditions that must absolutely prevent it. I do not mean only that the supposed diminishing areas will, as their including lines converge, presently come in contact with the eye itself; but I mean that long before they do this, the assumed diminution of the area becomes optically impossible. Though successively diminishing areas subtending the same angular space may be arranged as described so long as the eye is not approached too closely, yet as soon as the limit of its shortest focal adjustment is passed, this no longer holds: the retinal area occupied by the image, while it becomes gradually indefinite, enlarges rather than diminishes. And when we thus see that both the size of the eye and its optical adjustments necessarily enter as factors into the perceptions of visual areas and distances, it becomes manifest that there is a sense in which the consciousness of visual area is pre-determined by the inherited structure; not, indeed, to the same extent as the accompanying sense of colour is so pre-determined, but to some extent—to the extent that the visual organ, by its own size and constitution, furnishes certain limits within which the space-interpretations given to an impression of colour must eventually fall.

But a clearer understanding of the matter will be obtained, if we consider more at length a visual impression as it is received at the periphery of the nervous system. The retina, examined microscopically, presents a tesselated pavement made up of minute rods and cones packed side by side, so that their ends form a surface on which the optical images are received. As far as can be made out, each of these rods and cones is supplied by a separate nerve-fibril; and is, as must be supposed, capable of independent stimulation

That the joint action of these retinal elements may be the more easily comprehended, let us suppose an analogous structure on a large scale. Imagine that an immense number of fingers could be packed side by side, so that their ends made a flat surface; and that each of them had a separate nervous connexion with the same sensorium. If anything were laid on the flat surface formed by these finger-ends, an impression of touch would be given to a certain number of them—a number great in proportion to the size of the thing. And if two things successively laid on them differed in shape as well as in size, there would be a difference not only in the *number* of finger-ends affected, but also in the kind of *combination*. What would be the interpretation of any impression thus produced, while as yet no experiences had been accumulated? Would there be any idea of extension? Certainly not a developed idea, though there would be the crude material of an idea. To simplify the question, let the first object laid upon these finger-ends be a straight stick; and let us name the two finger-ends on which its extremes lie, A and Z. If now it be said that the length of the stick will be perceived, it is implied that the distance between A and Z is already known, or in other words, that there is a pre-existent idea of a special extension: which is absurd. If it be said that the extension is implied by the simultaneous excitation of B, C, D, E, F, and all the fingers between A and Z, the difficulty is not escaped; for no idea of extension can arise from the simultaneous excitation of these, unless there is a knowledge of their relative positions; which is itself a knowledge of extension. By what process then can the length of the stick become known? It can become known only after the accumulation of certain experiences, by which the series of fingers between A and Z becomes known. If the mass of fingers admits of being moved bodily, as the retina does; and if, in virtue of its movements, something now touched by finger A is next

touched by finger B, next by C, and so on; and if these experiences are so multiplied by motion in all directions, that between the touching by finger A and by any other finger, the number of intermediate touches that will be felt is known; then the distance between A and Z can be known—known, that is, as a series of states of consciousness produced by the successive touchings of the intermediate fingers—a series of states comparable with any other such series, and capable of being estimated as greater or less. And when, by numberless repetitions, the relation between any one finger and each of the others is established, and can be represented to the mind as a series of a certain length, we may understand how a stick laid on the surface so as at the same moment to touch all the fingers from A to Z inclusive, will be taken as equivalent to the series A to Z—how the *simultaneous* excitation of the entire row of fingers, will come to stand for its *serial* excitation—how thus, objects laid on the surface will come to be distinguished from one another by the relative lengths of the series they cover, or when broad as well as long, by the groups of series which they cover—and how by habit these simultaneous excitations, from being at first known indirectly by translation into the serial ones, will come to be known directly, and the serial ones will be forgotten: just as in childhood the words of a new language, at first understood by means of their equivalents in the mother tongue, are presently understood by themselves; and if used to the exclusion of the mother tongue, lead to the ultimate loss of it. The greatly-magnified apparatus here described, being reduced to its original shape—the surface of finger-ends being diminished to the size of the retina, the things laid on that surface being understood as images cast on the retina, and its movements in contact with these things being understood as movements of the retina relatively to the images—some conception will be formed of one part of the process by which our ideas of visual extension are de-

veloped. But now a very well-grounded criticism demands our attention. When the retina is thus described as made up of closely-packed units, separately excitable because connected with a nervous centre by separate fibres; and when it is argued that the excitation of any series of these comes to be known by experience as indicative of a certain linear extension; the interpretation is in great measure contained in the facts assumed. It is forgotten that in these clustered retinal elements, with their multitudinous separate fibres running to a place where they are put in relation with other nervous structures which receive the special impressions from special motions of the retina, there pre-exist the appliances through which such equivalences are to be established. The nervous structures concerned, no less than the optical and muscular structures, are already in great measure developed: certainly all the efferent and afferent fibres, and certainly to some considerable extent the central plexuses by which the visual impressions, serial and simultaneous, are co-ordinated. So that in fact the correlations and equivalences said to be established by experience between special retinal excitations received serially, and the answering retinal excitations which, when received simultaneously, indicate certain extensions, are lying latent in the structures with which the explanation sets out. All that can be reasonably inferred is, that these correlations and equivalences, mainly pre-determined by the structure of the organism, are changed from their potential to their actual forms by the experiences of the organism; and further that while the experiences disclose these latent connexions between certain nervous actions and between certain correlative states of consciousness, they further the development of the structures and determine their details—serving at the same time to give definiteness to their actions and to the accompanying perceptions. To this important qualification there must, however, be added an equally-important counter-

qualification. Though the explanation above given is inadequate if taken as applying only to the individual, it is not inadequate if taken as applying to the immeasurable series of antecedent individuals supposed by the hypothesis of Evolution. On referring back to the expositions contained in Part V., it will become manifest that the correlations between visual impressions and extensions, established little by little and inherited with continual accumulations, generation after generation, admit of being interpreted in the way described.

This analysis, however, involved as it is even in its simplest form, and much more involved as it is when taken with the qualifications just indicated, carries us only part way towards a solution of our problem—the perception of body as presenting statical attributes. Those motions of the eye required to bring the sentient elements of the retina successively in contact with different parts of the image, being themselves known to consciousness, become components of the perception. So too do those motions required to produce due convergence of the visual axes; and those further motions required to adjust each eye to the proper focus. Even when the several series of states of consciousness thus resulting, have been combined with those which proceed from the retina itself, they cannot give that developed notion of extension possessed by adults, until motions of the limbs and body have yielded those experiences through which distances are measured; and these are impossible without those accompanying tactual experiences that give the limits to distances. To examine in detail these various groups of elements which go to make up our perception of visible extension, would take up more pages than can here be spared. Nor is it needful for the establishment of general principles that they should be thus examined. The foregoing analysis shows that, leaving out of view other requirements (all of which involve motion and the accompanying states of conscious-

ness), no image cast on the retina can be understood, or even distinguished from another image widely different in form, until relations have been established between the separate sensitive agents of which the retina is constructed; that no relation between any two such agents can be known otherwise than through the series of sensations given by the intervening agents; that such series of sensations can be obtained only by motion of the retina; and that thus the primitive element out of which our ideas of visible extension are evolved, is a cognition of the relative positions of two states of consciousness in some series of such states consequent upon a subjective motion. Not that such relation between successive states of consciousness gives in itself any idea of extension. We have seen that a set of retinal elements may be excited simultaneously, as well as serially; that so, a quasi-single state of consciousness becomes the equivalent of a series of states; that a relation between what we call *coexistent positions* thus represents a relation of *successive positions;* that this symbolic relation being far briefer, is habitually thought of in place of that which it symbolizes; and that, by the continued use of such symbols and the union of them into more complex ones, are generated our ideas of visible extension—ideas which, like those of the algebraist working out an equation, are wholly unlike the ideas symbolized, and which yet, like his, occupy the mind to the entire exclusion of the ideas symbolized.

The fact, however, which it now more particularly behoves us to remember, is, that underlying all cognitions of visible extension, is the cognition of relative position among the states of consciousness accompanying motion.

§ 328. From the visual perception of body as presenting statical attributes, we pass to the tactual perception of it—to such perception of Form, Size, and Position, as a blind man has. And before dealing with this perception in its totality, let us look at its components: considering these

first as known to us, and then in our mode of knowing them.

It is an anciently-established doctrine that Form or Figure, which we may call the most complex mode of extension, is resolvable into relative magnitude of parts. An equilateral triangle is one of which the three sides are alike in their lengths. An ellipse is a symmetrical closed curve, of which the transverse and conjugate diameters are the one greater than the other. A cube is a solid having all its surfaces of the same magnitude, and all its angles of the same magnitude. A cone is a solid, successive sections of which, made at right angles to the axis, are circles regularly decreasing in magnitude as we progress from base to apex. Any object described as narrow, has a breadth of small magnitude compared with its length. A symmetrical figure is one in which the homologous parts on opposite sides are equal in magnitude. Moreover, an alteration in the form of anything, is an alteration in the comparative sizes of some of its parts—a change in the relations of magnitude subsisting between them and the other parts. Hence, form being resolvable into relations of magnitude, we may go on to analyze that out of which these relations arise—magnitude itself.

On passing from a mode of extension which consists in relations of magnitude, to consider magnitude itself, it would seem that relativity is no longer involved; but this is not really the case. Of absolute magnitude we can frame no conception. All magnitudes as known to us are thought of as equal to, greater than, or less than, certain other magnitudes. In speaking of a house as large, we mean large in comparison with other houses; in calling a man short, we mean short in comparison with most men; in describing Mercury as small and a certain pin's head as big, we mean in comparison with planets and pins' heads respectively. And further we can have no general notion of magnitude save one constructed out of the magnitudes

given to us in experience, and therefore, thought of in relation to them. In what, then, consists the difference between figure and size as known to us? Simply in this:—When thinking of a thing's figure, we think of the relations of magnitude which its constituent parts bear to one another; but when thinking of its size, we think of the relation of magnitude which it, as a whole, bears to other wholes. Still there remains the question—What is a magnitude considered analytically? The reply is—It consists of relations of position. When we conceive anything as having a certain bulk, we conceive its opposite limiting surfaces as more or less removed from each other; that is—as related in position. When we think of a particular area, we think of a surface having boundary lines standing to one another in specific degrees of remoteness; that is—as related in position. When we imagine a line of definite length, we imagine its termini as occupying places in space having some positive distance from each other; that is—as related in position. A solid is decomposable into planes; a plane into lines; lines into points; and as adjacent points cannot be conceived as distinct from each other, without being conceived as having relative positions, it follows that every cognition of magnitude is a cognition of relations of position, which are presented to consciousness as like or unlike other relations of position.

This analysis brings us to the remaining space-attribute of body—Position. Like Magnitude, Position cannot be known absolutely; it can be known only relatively. The position of a thing is inconceivable, save by thinking of that thing as at some distance from one or more other things. Imagine a solitary point A, in space which has no assignable bounds; and suppose it possible for that point to be known by a being having no locality. What can be predicated respecting its place? Absolutely nothing. Imagine another point B, to be added. What can now be predicated respecting the two? Still nothing. Neither point having any

attribute save position, the two are not comparable in themselves; and nothing can be said of their relative position from lack of anything with which to compare it. The distance between them may be either infinite or infinitesimal, according to the measure used; and as, by the hypothesis, there exists no measure—as space contains nothing save these two points, the distance between them is unthinkable. But suppose that a third point C, is added. Immediately it becomes possible to frame a proposition respecting the positions of the three. The two distances A to B, and A to C, serve as measures to each other. The space between A and B may be compared with the space between A and C; and the relation of position in which A stands to B, is thinkable as like or unlike the relation in which A stands to C. Position, then, is not an attribute of body in itself, but only in its connexion with the other contents of the universe.

Relations of position are of two kinds: those which subsist between subject and object; and those which subsist between either different objects, or different parts of the same object. Of these the last are resolvable into the first. On remembering that in the dark a man can discover the relative positions of two objects only by touching first one and then the other, and so inferring their relative positions from his own position towards each; and on remembering that by vision no knowledge of their relative positions can be reached save through a perception of the distance of each from the eye; it becomes clear that ultimately, all relative positions may be decomposed into relative positions of subject and object.

These conclusions—that Figure is resolvable into relative magnitudes; that Magnitude is resolvable into relative positions; and that all relative positions may finally be reduced to positions of subject and object—will be fully confirmed on considering the process by which the space-attributes of body become known to a blind man. He puts out his hand, and touching something, thereby learns its position

with respect to himself. He puts out his other hand, and meeting no resistance above, or on one side of, the position already found, gains some negative knowledge of the thing's magnitude—a knowledge which three or four touches on different sides of it serve to render positive. And then, by moving his hands over its surface, he acquires a notion of its figure. What, then, are the elements out of which, by synthesis, his perceptions of magnitude and figure are framed? He has received nothing but simultaneous and successive touches. Each touch established a relation of position between himself and the point touched. And all he can know respecting magnitude and figure—that is, respecting the relative positions of these points to one another—is necessarily known through the relative positions in which they severally stand to himself.

Our perceptions of all the space-attributes of body, being thus decomposable into perceptions of positions like that gained by a single act of touch, we have next to inquire what is contained in a perception of this kind. Obviously to perceive the position of anything touched, is to perceive the position of that part of the body in which the sensation of touch arises. Whence it follows that our knowledge of the positions of objects, is built upon our knowledge of the positions of our members towards one another—knowledge both of their fixed relations, and of those temporary relations they are placed in by every change of muscular adjustment. That this knowledge is gained by bringing each part in contact with the others and moving the parts over one another in all possible ways; and that the motions as well as the touches involved in these mutual explorations, are known by their reactions upon consciousness; are propositions that scarcely need stating. But it is manifestly impossible to carry the analysis further without analyzing our perception of motion. Relative position and motion are two sides of the same experience. We can neither conceive motion without conceiving relative position, nor dis-

cover relative position without motion. For the present, therefore, we must be content with the conclusion that, whether visual or tactual, the perception of every statical attribute of body is resolvable into perceptions of relative position which are gained through motion.

§ 329. Before defining in its totality the perception of body as presenting statical attributes, it is needful to remark that the resisting positions which, as co-ordinated in thought, constitute the consciousness of Magnitude or of Figure, must be aggregated—must be continuous with an assemblage of intermediate resisting positions. If they are discontinuous—if they are separated by positions that do not resist, we have a perception not of the space-attributes of one body, but of the space-attributes of two or more.

Premising this, and omitting as doubly mediate our visual perceptions, we may say that the perception of body as presenting statical attributes, is a composite state of consciousness, having for its primary elements the indefinite impressions of resistance and extension, *unconditionally* united with each other and with the subject in relations of coincidence in time and adjacency in space; and having for its secondary elements sundry definite impressions of resistances, variously united with each other in relations of simultaneity and sequence that are severally *conditional* on the nature of the object and the acts of the subject, and all of them *conditionally* united with the primary elements by relations of sequence.

To which there is only to add, as before, that these being the *materials* of the perception, the *process* of perception consists in the unconscious classing of these impressions, relations, and conditions, with the like before-known ones.

CHAPTER XIV.

THE PERCEPTION OF SPACE.

§ 330. In the last chapter, much has been tacitly asserted respecting our perception of Space. The consideration of occupied space cannot be dissociated from the consideration of unoccupied space. The two being distinguished as resistant extension and non-resistant extension, it is impossible to treat of either without virtually treating of both. Substantially, therefore, the inquiry on which we are now to enter must be a continuation of the one just concluded. Before commencing it, something must be said in answer to those who, holding with Kant that Space is a form which belongs to the subject and not to the object, consider all attempts to analyze our consciousness of it as absurd.

Among these, is Sir William Hamilton; who says that "it is truly an idle problem to attempt imagining the steps by which we may be supposed to have acquired the notion of extension; when in fact we are unable to imagine to ourselves the possibility of that notion not being always in our possession."

On this proposition the first comment to be made is that a philosopher, dealing with questions of so subtle a kind, becomes a doubtful guide when he hampers the statement of his doctrine by a phrase which seems to mean something but really means nothing; as in the last clause of the passage I have quoted. The entire fact to which Sir W.

Hamilton refers is this:—I am conscious of space. I seek to expel the consciousness of space and fail. I try to recall a time when I had not the consciousness of space and cannot do so. And I express the result of these attempts by saying that I cannot imagine myself as not having the consciousness of space. But now, (supposing even that this statement is admissible without reservation, which it is not) to say that I cannot imagine the "possibility" of ever having been without this consciousness, is to use words which have no answering thoughts. If I cannot now get rid of the consciousness of space, and (which is tacitly implied) cannot think of any past experiences free from that consciousness; I am thereby debarred from predicating to myself anything about the "possibility" or impossibility of ever having been without the consciousness. For to imagine the possibility of the absence is really to imagine the absence itself. If I use words not idly as mere symbols, but for their proper purpose of indicating certain states of my mind, then, when I say that I can think of a thing as possible, I mean that it lies within the power of my representative faculty to put together in thought the terms of the proposition. And therefore if I ask whether it is possible or impossible to think of myself as having ever been without the notion of space, I imply that it lies within the power of my representative faculty to associate or dissociate the two terms of the proposition, self and space. But if I have already recognized the fact that I cannot expel this consciousness, I have recognized the fact that it is beyond the power of my representative faculty to associate or dissociate the terms of the proposition; and that therefore all question about the possibility or impossibility of imagining any other state is excluded.

But now, granting for argument's sake all which Sir William Hamilton has the power to allege, that we cannot conceive ourselves as ever having been without the notion of extension, it does not follow either that extension is a form of intuition, or that we are disabled from analyzing the

notion we have of it. Those who have followed the line of argument running through Parts III., IV., and V., and more especially those who remember the contents of §§ 208, 237—247, will see that our inability to banish from our minds the idea of space is readily to be accounted for on the experience-hypothesis. If space be an universal form of the *non-ego*, it must produce some corresponding universal form in the *ego*—a form which, as being the constant element of *all* impressions presented in experience, and therefore of *all* impressions represented in thought, is independent of every *particular* impression; and consequently remains when every particular impression is, as far as possible, banished. And then, to the argument that whether extension is a form of intuition or not, our inability to conceive ourselves as ever having been without it, disables us from analyzing it, I reply, that while we may be disabled from analyzing it directly we may remain able to analyze it indirectly. Though examination of mental processes subjectively may not disclose any anterior elements out of which to construct the consciousness of space; yet, by examining mental processes objectively, we may gain the means of conceiving how our own consciousness of space was constructed. As we learn vicariously that our eyes make visible movements when we glance from one thing to another, though we can never see our own eyes move; so we may learn vicariously how space has become a form of thought, even admitting that we cannot conceive our consciousness as remaining in the absence of this form.

But what is here granted for argument's sake may be rightly denied. This alleged inability to conceive of consciousness as existing without the notion of extension, I, for one, do not admit. I find it quite possible to think of myself as having possessed states of consciousness not involving any notion of extension—quite possible to imagine trains of thought in which space is not implied. It is a vice of the older psychology, and of the Kantian

psychology included, that it habitually deals only with the consciousness of the adult: ignoring the obvious fact that the developed apparatus of thought possessed by the adult is not possessed by the infant, but is slowly evolved; and ignoring the further fact that associations unquestionably established and consolidated by experience, are so carried by us into all our thinkings that we are constantly in danger of attributing to the undeveloped mind ideas which only the developed mind possesses. It is a further vice of the Kantian psychology in its exposition of this hypothesis respecting forms of intuition, that, instead of citing in proof intuitions of all orders, it cites intuitions of those orders only with which the consciousness of space is most directly connected in experience. If we refuse thus to limit the inquiry—if passing over the sensations gained through touch and vision, we contemplate certain others; and if we figure ourselves as devoid of certain perceptions that are *known* to be acquired; it at once becomes easy to conceive ourselves as having thoughts that do not imply space.

Remembering that, as Sir William Hamilton himself expresses it, "we are never aware even of the existence of our organism, except as it is somehow affected;" let us suppose a human being absolutely without experience, and therefore, as yet unacquainted with his own body. It is admitted by Kant that space being but a *form* of intuition cannot exist before intuition—cannot be known in itself antecedently to experience, but that it is disclosed in the act of receiving experiences. His doctrine is that the matter of perception being given by the *non-ego*, and the form by the *ego*, the form and the matter come into consciousness simultaneously. In the supposed case, therefore, there is yet no notion of space. Let the first impressions received be those of sound No one will allege that sound, as an affection of consciousness, has any space-attributes. And even those who have little considered such questions will admit that

our knowledge of sound as coming from this or that point in space, is a knowledge gained by experience—is a knowledge not *given* along with the sound but *inferred* from certain modifications of the sound. When being deluded by a ventriloquist and led to draw wrong inferences, or when, respecting the whereabouts of a humming gnat at night we can draw no inference, we get clear proof that primarily sound is known only as pure sensation. Further, let it be observed that the sensation of sound is of a kind which does not in itself make us "aware of the existence of our organism, as somehow affected." Only by experience do we learn that we hear through the ears. Auditory impressions are so indistinctly localized that, in spite of their associations, most adults even will perceive that in the absence of acquired knowledge they would not know whereabouts in the body they were sentient. Hence, in the supposed state of nascent intelligence, sensations of sound, not having in themselves any space-implications, and not in themselves disclosing any part of the organism as affected, would be nothing more than simple affections of consciousness, which would admit of being remembered and compared without any notion of extension being involved. Having duly contemplated the case thus objectively presented, any one ordinarily endowed with imagination, will, I think, by closing his eyes, arranging his body so as to give as few disturbing sensations as possible, and banishing to the greatest extent practicable all remembrance of surrounding things, be able to conceive a state in which a varied series of sounds known as severally like and unlike, and thought of solely in respect to their mutual relations, would be the entire contents of consciousness.

With such further reasons for holding that Space, considered as subjective, is derived by accumulated and consolidated experiences from Space considered as objective, we may be encouraged to continue that analysis of our

perception of it collaterally entered upon in the last chapter.

§ 331. Let us start afresh from the conclusions there reached. They were that, whether visual or tactual, every perception of the space-attributes of body is decomposable into perceptions of relative position; that all perceptions of relative position are decomposable into perceptions of the relative position of subject and object; and that these relations of position are knowable only through motion. Such being now our data, the first question that arises is—How, through experiences of occupied extension, or body, can we ever gain the notion of unoccupied extension, or space? How, from the perception of a relation between resistant positions, do we progress to the perception of a relation between non-resistant positions? If all the space-attributes of body are resolvable into relations of position between subject and object, disclosed in the act of touch—if, originally, relative position is only thus knowable — if, therefore, position is, to the nascent intelligence, incognizable except as the position of something that produces an impression on the organism; how is it possible for the idea of position ever to be dissociated from that of body?

This problem, difficult of solution as it appears, is really a very easy one. If, after some particular motion of a limb there invariably came a sensation of softness; after some other, one of roughness; after some other, one of hardness—or if, after those movements of the eye needed for some special act of vision, there always came a sensation of redness; after some others, a sensation of blueness; and so on —it is manifest that, in conformity with the laws of association, there would be established constant relations between such motions and such sensations. If positions were conceived at all, they would be conceived as invariably occupied by things producing special impressions; and it would be impossible to dissociate the positions from the

things. But as we find that a certain movement of the hand which once brought it in contact with something hot, now brings it in contact with something sharp, and now with nothing at all; and as we find that a certain movement of the eye which once was followed by the sight of a black object, is now followed by the sight of a white object, and now by the sight of no object; it results that the idea of the particular position accompanying each one of these movements, is, by accumulated experiences, *dissociated* from objects and impressions. It results, too, that as there are endless such movements, there come to be endless such positions conceived as existing apart from body. And it results, further, that as in the first and in every subsequent act of perception, each position is known as coexistent with the subject, there arises a consciousness of countless such coexistent positions; that is—of Space. This is not offered as an ultimate interpretation; for, as before admitted, the difficulty is to account for our notion of relative position. All that is here attempted is, partially to explain how, from that primitive notion, our consciousness of Space in its totality is built up.

Carrying with us this idea, calling to mind the structure of the retina as described in the last chapter, and remembering the mode in which the relations among its elements are established, it will, I think, become possible to conceive how that wonderful perception we have of visible space is generated. It is a peculiarity of sight that it makes us partially conscious of many things at once. On now raising my head, I take in at a glance, desk, papers, table, books, chairs, walls, carpet, window, and sundry objects outside: all of them simultaneously impressing me with various details of colour, suggesting surface and structure. True, I am not *equally* conscious of all these things at the same time. I find that some one object at which I am looking is more distinctly present to my mind than any other, and that the one point in this object on which the visual axes

converge is more vividly perceived than the rest. In fact, I have a perfect perception of scarcely more than an infinitesimal portion of the whole visual area. Nevertheless, even while concentrating my attention on this infinitesimal portion, I am in some degree aware of the whole. My complete consciousness of a particular letter on the back of a book, does not exclude a consciousness that there are accompanying letters—does not exclude a consciousness of the book—does not exclude a consciousness of the table on which the book lies—nay, does not even exclude a consciousness of the wall against which the table stands. All these things are present to me in different degrees of intensity—degrees that become less, partly in proportion as the things are unobtrusive in colour and size, and partly in proportion as they recede from the centre of the visual field. Not that these many surrounding things are definitely known as such or such; for, while keeping my eyes fixed on one object, I cannot make that assertory judgment respecting any adjacent object which a real cognition of it implies, without becoming, for the moment, imperfectly conscious of the object on which my eyes are fixed. But notwithstanding all this, it remains true that these various objects are in some sense present to my mind—are incipiently perceived—are severally tending to fill the consciousness—are each of them partially exciting the mental states that would arise were it to be distinctly perceived.

This peculiarity in the faculty of sight (to which there is nothing analogous in the faculties of taste and smell; which, in the faculty of hearing, is vaguely represented by our appreciation of harmony; and which is but very imperfectly paralleled in the tactual faculty by the ability we have to discern irregularities in a surface on which the hand is laid) is clearly due to the structure of the retina. Consisting of multitudinous sensitive elements each capable of independent stimulation, it results that when an image is received by the retina, each of those sensitive elements on

which the variously-modified rays of light fall, is thrown into a state of greater or less excitement. Each of them, as it were, *touches* some particular part of the image; and sends inwards to the central nervous system the impression produced by the touch. But now observe that, as before explained, each retinal element has come to have a known relation to every one of those around it—a relation such that their synchronous excitation serves to represent their serial excitation. Lest this symbolism should not have been fully understood, I will endeavour further to elucidate it. Suppose a minute dot to be looked at—a dot so small that its image, cast on the retina, covers only one of these sensitive elements, A. Now suppose the eye to be so slightly moved that the image of this dot falls on the adjacent element B. What results? Two slight changes of consciousness: the one proceeding from the new retinal element affected; the other from the muscles producing the motion. Let there be another motion, such as will transfer the image of the dot to the next element C. Two other changes of consciousness result. And so on continuously: the consequence being that the relative positions in consciousness of A and B, A and C, A and D, A and E, &c., are known by the number of intervening states. Imagine now that instead of these small motions separately made, the eye is moved with ordinary rapidity; so that the image of the dot sweeps over the whole series A to Z in an extremely short time. What results? It is a familiar fact that all impressions on the senses, and visual ones among the number, continue for a certain brief period after they are made. Hence, when the retinal elements forming the series A to Z are excited in rapid succession, the excitation of Z commences before that of A has ceased; and for a moment the whole series A to Z remains in a state of excitement together. This being understood, suppose the eye is turned upon a line of such length that its image covers the whole series A to Z. What results? There is

a simultaneous excitation of the series A to Z, differing from the last in this; that it is persistent, and that it is unaccompanied by sensations of motion. But does it not follow from the known laws of association, that as the simultaneous excitation is common to both cases, it will, in the last case, tend to arouse in consciousness that series of states which accompanied it in the first? Will it not tend to *consolidate* the entire series of such states into one state? and will it not thus come to be taken as the equivalent of such series? There cannot, I think, be a doubt of it. And if not, then we may see how an excitement of consciousness by the coexistent positions constituting a line, serves as the representative of that serial excitement of it which accompanies motion along that line. Let us return now to the above-described state of the retina as occupied by an image or by a cluster of images. Relations of coexistent position like those we have here considered in respect to a particular linear series, are established throughout countless such series in all directions over the retina: so putting each element in relation with every other. Further, by a process analogous to that described, the state of consciousness produced by the focal adjustment and convergence of the eyes to each particular point, has been made a symbol of the series of coexistent positions between the eyes and that point. After dwelling awhile on these facts, the genesis of our visual perception of space will begin to be comprehensible. Every one of the retinal elements simultaneously thrown into a state of partial excitement, arousing as it does not only a partial consciousness of the sensation answering to its own excitement, but also a partial consciousness of the many relations of coexistent position established between it and the rest, which are all of them similarly excited and similarly suggestive; there results a consciousness of a whole *area* of coexistent positions. Meanwhile the particular consciousness that accompanies adjustment of the eyes, calling up as it does the line of

coexistent positions lying between the subject and the object specially contemplated; and each of the things, and parts of things, not in the centre of the field, exciting by its more or less definite image an incipient consciousness of its distance, that is, of the coexistent positions lying between the eye and it; there is awakened a consciousness of a whole *volume* of coexistent positions—of Space in three dimensions. Along with a *complete* consciousness of the one position to which the visual axes converge, arises a *nascent* consciousness of an infinity of other positions—a consciousness that is nascent in the same sense that our consciousness of the various objects out of the centre of the visual field is nascent. One addition must be made. As the innumerable relations subsisting among these coexistent positions were originally established by motion; as each of these relations came by habit to stand for the series of mental states accompanying the motion which measured it; as every one of such relations must, when presented to consciousness, still tend to call up in an indistinct way that train of feelings accompanying motion, which it represents; and as the simultaneous presentation of an infinity of such relations will tend to suggest an infinity of such experiences of motion, which, as being in all directions, must so neutralize one another as to prevent any particular motion from being thought of; there will arise, as their common resultant, that sense of *ability to move,* that sense of *freedom for motion,* which forms the remaining constituent in our notion of Space.

Any one who finds it difficult to conceive how, by so elaborate a process as this, there should be reached a notion apparently so simple, so homogeneous, as that which we have of Space, will feel the difficulty diminished on recalling these several facts:—First, that the experiences out of which the notion is framed and consolidated are in their essentials the same for ourselves and for the ancestral races of creatures from which we inherit our organizations,

and that these uniform ancestral experiences, potentially present in the nervous structures bequeathed to us, constitute a partially-innate preparedness for the notion; second, that the individual experiences which repeat these ancestral experiences commence at birth, and serve to aid the development of the correlative structures while they give them their ultimate definiteness; third, that every day throughout our lives, and throughout the whole of each day, we are repeating our experiences of these innumerable coexistences of position and their several equivalences to the serial states of feeling accompanying motions; and fourth, that after development is complete these experiences invariably agree —that these relations of coexistent positions are unchangeable—are ever the same towards each other and the subject —are ever equivalent to the same motions. On bearing in mind this inheritance of latent experiences, this early commencement of the experiences that verify and complete them, this infinite repetition of them, and their absolute uniformity; and on further remembering the power which, in virtue of its structure, the eye possesses of partially suggesting to the mind countless such experiences at the same moment; it will become possible to conceive how we acquire that consolidated idea of space in its totality, which at first seems so inexplicable. On developing somewhat further a late illustration, we shall be enabled to conceive this still more clearly. By habit each of the groups of letters now before the reader has acquired a seemingly-inherent meaning—has ceased to be a mere series of straight and bent strokes, and has actually, as it were, *absorbed* some of the thought for which it stands. Moreover in our intellectual operations, these clusters of symbols have come to be the elements with which we think, and are so habitually used to the exclusion of the things they signify, as to cause frequent mistakes. This being so, it is easy to see how, with symbols learnt much earlier, symbols incomparably more simple, uniform, and exact, symbols

used every instant of our waking lives, a like transformation and substitution has been carried much further. And when this is understood, it may also be understood how the state of consciousness answering to any group of coexistent positions made known by the senses, has supplanted in our minds the series of states of consciousness to which it was equivalent; and how, consequently, our space-perceptions have become a language in which we think of surrounding things, without at all thinking of those experiences of motion which this language expresses.

§ 332. Its most finished form will be given to this interpretation by going on to consider how it enables us to understand the origin of the space-intuitions which we recognize as necessary. The general theory of these the reader will at once see is that they are the fixed functions of fixed structures that have become moulded into correspondence with fixed outer relations. In elaborating this general theory into a more special form, such repetitions as may be needed will, I think, be justified by the result.

I take a pin's head, place it on a table, retreat towards the far side of the room, and presently reach a distance at which I can no longer see the pin's head. The structure I have inherited determines a fixed limit to the distance at which a fixed area can produce on me a visual impression. The pin's head becomes visible again as I approach the table; its apparent area (or quantity of consciousness of coexistent positions it produces in me) goes on increasing; until at length, when my eye is within a few inches, this area becomes the largest possible consistent with that definiteness implied by a perception of the object and its place as such and such. For if my eye continues to be brought nearer, the apparent area, while enlarging, becomes gradually more confused in character and indefinite in outline; so that in the absence of previous knowledge I should be unable to say from what it proceeded. Thus

there are both near and remote limits to the distance at which a given extension can so affect me as to cause a visual consciousness of it. That is to say, the organization bequeathed to me partially pre-determines the relations between certain outer magnitudes and distances and certain inner perceptions to be produced by them.

More than these limitations are thus potentially present. Between each consciousness of an area subtended by any object and the consciousness of the distance at which it subtends this area, there is a relation lying latent in the optical, muscular, and nervous structures—not a relation such that at the outset its terms are completely adjusted; but a relation such that the one consciousness arouses a vague form of the other, which individual development and experience make a definite form. The image of a square foot placed ten yards off, covers a precisely-limited area of the retina; and at the same time the muscular contractions by which the two eyes are converged on the square foot, and focally adjusted to it, form a combination which alone can produce clear vision of an object ten yards off. Thus the inherited structure is such that the square foot placed at the distance of ten yards cannot be distinctly perceived without there arising a relation between a specific number of the retinal elements covered by the image and a specific adjustment of the ocular muscles: both implying specific states of consciousness. And similarly with every other distance. This is not all. While the retinal area covered by the image of the square foot at each distance, has a definite relation to the muscular adjustment required to bring it into focus at that distance; there is also a definite relation between every different position of the square foot to the right or to the left, above or below, and the particular group of retinal elements which its image will cover; and there is also a definite relation between every such position and the particular set of muscular movements required to direct the eyes upon it so as to bring its image into the

centre of the retina. All these correlations are in great measure pre-established—are pre-established so far as the inherited organization is developed at the time it comes into activity; and this activity can do no other than complete the structure, and change the innate vague connexions among the accompanying states of consciousness into definite connexions.

To a like extent pre-determined by the inherited organization, and similarly made precise by the individual experiences which accompany the development of this inherited organization, are the correlations between these visual impressions and the tactual and muscular impressions derived by the limbs from the same objects. The square foot a yard off requires a certain muscular motion to reach it, and other muscular motions to move the hands round it; and the quantities and combinations of these are related to the quantities and combinations of the visual impressions yielded by the square foot at that distance. The square foot cannot be brought nearer, or moved towards either side, without there occurring simultaneous changes, definitely related to one another, between the feelings which tactual exploration gives and the feelings which vision gives. And the like holds between the visual feelings and the feelings that attend locomotion, when the object is beyond reach. Clearly, correlations of these kinds are dependent on the sizes and structures of the body and limbs, as standing in connexion with the sizes and structures and positions of the eyes. Not forgetting the fact that the same sensations of touch may be gained by muscular adjustments that differ somewhat, we may say that the conceptions of space-relations to be disclosed in experience by muscular motions, are mainly fixed beforehand by the inherited structures.*

* A qualification must be appended. It may properly be objected to this doctrine, when offered for full acceptance, that it takes no note of the changes of proportions among visual and motor appliances that go on during development. The length of a man's arm is some three times the length

Little more need be said to make it clear how certain primary space-relations are presented to consciousness under the form of necessary relations. If a segment of a circle be looked at, the image of it cast on the retina is necessarily such that the arc covers a greater number of retinal elements than the chord; and since each of these retinal elements yields its separate impression to consciousness, the series of impressions produced by the arc is felt as larger than the series produced by the chord. This continues to hold however much the arc is flattened: so long as it has any perceptible curvature at all, it is felt to be longer than the chord uniting its extremes. Parallel experiences are derived from the ocular muscles. Carrying the eye along the line of the curve, yields to consciousness a greater quantity of sensation than carrying the eye along the chord does. As the curve is flattened this difference

of an infant's arm; but neither the diameter of a man's retina nor the space between his eyes is anything like three times that of the corresponding dimension in the infant. Consequently the ocular adjustments and answering sensations which vision of a near object produces in an infant, bear ratios to the muscular adjustments and feelings which tactual exploration of it gives, different from the ratios which they bear to one another in a man. Hence that these nervo-muscular acts and accompanying mental states which answer to certain positions in space, are pre-adjusted in the race under a special form like that which they have in the adult, seems untenable. Two considerations serve to dispose of this difficulty; while they qualify in a needful way the original statement. The one is, that the correlation of structures and of potential mental states accompanying their actions, being inherited by the infant in a proximate form, is progressively modified by the daily activities that accompany development, until it reaches the complete form: individual experiences thus serving to finish what is but rudely sketched out at birth. The other is, that apart from activities and concomitant experiences, there go on spontaneously, during development, structural modifications which complete the adjustment of the organism to the environment, as that adjustment existed in adult ancestors. Among many undeniable proofs of this, the most conspicuous is furnished by the establishment of the reproductive capacity. Various correlated developments in different parts of the organism, including the nervous centres, commence at puberty, and complete themselves quite independently of functional actions. Evidently, then, we have good ground

diminishes; but some of it continues as long as the curve continues appreciable. Thus the truth that a straight line is the shortest line between two points, lies latent in the structures of the eyes and the nervous centres which receive and co-ordinate visual impressions. We cannot think otherwise because, during that adjustment between the organism and the environment which evolution has established, the inner relations have been so moulded upon the outer relations that they cannot by any effort be made not to fit them. Just in the same way that an infant's hand, constructed so as to grasp by bending the fingers inwards, implies ancestral hands which have thus grasped, and implies objects in the environment to be thus grasped by this infantine hand when it is developed; so the various structures fitting the infant for apprehensions of space-relations, imply such apprehensions in the past by its ancestors and in the

for the belief that the correlations here in question, different in the child from the answering correlations in the adult, undergo a continuous re adjustment during the growth of the child, in virtue of processes equally spontaneous with those which determine its growth: the experiences it receives from moment to moment during the development, serving but to facilitate the re-adjustment pre-determined by its constitution. Nevertheless, while we ascribe the general forms of these correlations to inherited structures, and ascribe to inherited tendencies the modifications that go on in these structures during growth, we must not overlook the fact that individual experiences are capable of doing much. Not only in the sensations they yield do they furnish the concrete terms for these relations out of which our space-consciousness is built; and not only by their repetitions do they serve to give precision to the consciousness of each particular relation; but they work such effects upon the associations of ideas and answering nervous connexions as suffice, in some cases, to invert the inherited relations. The testimony of the microscopist demonstrates this. As before pointed out, (§ 204) he becomes in course of time so accustomed to see in the microscopic image a reversal of those motions which his fingers produce in the object he is examining, that he ceases to be conscious of the contradiction—nay more, when he comes to use an "erecting glass," which re-reverses the apparent motion and makes it in the same direction as it would appear without the microscope, he becomes completely puzzled, and bungles just as he did when he originally had to learn to reverse the motions.

future by itself. And just as it has become impossible for the hand to grasp by bending the fingers outwards instead of inwards; so has it become impossible for those nervous actions by which we apprehend primary space-relations to be reversed so as to enable us to think of these relations otherwise than we do.

It will probably be remarked that this view approaches to the view of Liebnitz; and some perhaps will think that it does not differ very widely from that of Kant. Already I have pointed out (§ 208) that the hypothesis of Evolution "supplies a reconciliation between the experience-hypothesis as commonly interpreted and the hypothesis which the transcendentalists oppose to it;" and here we see how complete the reconciliation is. For while we are enabled to recognize the truth which lies in the doctrine of a "pre-established harmony," and the truth which lies in the doctrine of "forms of intuition;" we are enabled to interpret these truths as corollaries from the doctrine that all intelligence is acquired through experience: we have but to expand this doctrine so as to make it include, with the experience of each individual, the experiences of all ancestral individuals. By regarding these data of intelligence as *à priori* for the individual, but *à posteriori* for that entire series of individuals of which he forms the last term, we escape the difficulties of both hypotheses as currently understood.

The argument may be fitly concluded by glancing at sundry peculiarities in our conception of space, quite irreconcilable with the Kantian hypothesis, but harmonizing completely with the hypothesis that has been set forth.

§ 333. Our various epi-peripheral feelings carry with them the consciousness of space in degrees that range from no consciousness up to extremely vivid consciousness. As already pointed out, sensations of sound do not of themselves yield the consciousness of space: it is only through

experience that we associate them with outer objects. Much the same may be said of odours. No thought of position originally accompanies a sensation of smell: it is by experiment that we learn the connexions between smells and things yielding them, and so come to think of them as in space. Some space-consciousness accompanies the sensation of taste: not only through the tactual feelings it gives to the tongue and palate do we know the position of a sapid morsel, but we can vaguely perceive its whereabouts by a localized intensity of the sensation of taste. Relatively clear and extensive and varied is the space-consciousness that goes along with tactual feelings. Though the man born blind has but a very imperfect notion of space, and a notion composed in a different way from that of persons who can see, yet it is a notion much greater than that given along with taste. But so immensely more vivid and comprehensive is the consciousness of space accompanying visual sensations, that we habitually think of it as accompanying these only. Now let us ask, with what other series of contrasts do these contrasts go? They go along with the contrasts between the mobilities of the sense-organs, relatively to the stimuli they receive. The sensitive surface within either ear cannot be so moved about in relation to the incoming vibrations as to expose now one part and now another to them: all that can be done is to shift the head in such way as to vary the intensity of the sound-waves that fall on either ear and on the two ears. Similarly with smell. The olfactory tract is fixed in relation to the body of inhaled odour: it can simply be brought as a whole nearer to or further from the source of the sensation. Along with tastes we have seen that a certain amount of space-consciousness is directly given; and here we see that the sense-organ is movable with respect to the source of its stimulation. Far more marked is the mobility of the sentient surface in relation to the object affecting it, when we pass to the case of touch; and it is observable, also,

that the space-consciousness accompanying tactual sensations is clear in proportion as the parts whence the sensations come are mobile. We cannot form any such distinct conceptions of the sizes and shapes of things explored by our backs or legs, as we can of the sizes and shapes of things explored by our hands. But it is when we come to the eyes that we reach the greatest mobility of the parts relatively to their stimuli: not, indeed, relatively to the actual outer objects, but relatively to the images of those objects cast on the retinæ. For the retinæ, made up of multitudinous independent sensitive agents, can be moved with immense facility all about the images falling upon them. With a quickness almost too great to note, the contractions that converge the eyes and adjust their foci are effected; and by other contractions the clustered feelers which make up the retinæ are swept from side to side, and up and down, over the image; touching all its parts in countless combinations and successions. Here, then, we have the highly-significant fact that the space-consciousness accompanying each kind of sensation derived from the outer world, is great in proportion to the variety and rapidity of the sensations of motion which go along with the receipt of it —a fact obviously to be expected if the foregoing interpretation is true.

Another peculiarity in our perception of space is worth noting. If the reader, while looking at his hand or any equally-close object, will consider what consciousness he has of the space lying between it and his eyes, he will perceive that his consciousness of it is, as it were, exhaustive. He has an extremely complete or detailed perception of it. If he now directs his eyes to the farther side of the room, and contemplates an equal portion of space there, he finds that he has much less knowledge of it. He has nothing like so intimate an acquaintance with its constituent parts. If, again, looking through the window, he observes what consciousness he has

of a space a hundred yards away, he discovers it to be in still less specific consciousness. And on gazing at the distant horizon he becomes aware that he has scarcely any perception of that far-off space—has rather an indistinct *con*ception than a distinct *per*ception. But this is exactly the kind of knowledge that would result from experiences organized as above described. Of the space within range of our hands we have the most complete perception, because we have had myriads of experiences of relative positions within that space. And of space as it recedes from us we have a less and less complete perception, because our experiences of relative positions contained in it have been fewer and fewer.

A kindred peculiarity in our space-perceptions, which was indicated in § 119, has a like implication. We saw that when the eyes are adjusted to see any object, or part of an object, "we become conscious of the space it occupies, and of the closely-environing space, with much more distinctness than we are conscious of any other space." Now if our consciousness of space results from organized and inherited experiences, verified and completed during the activity and development of the individual, this peculiarity must inevitably result from the ordinary process of association. For those feelings, visual, tactual, and muscular, which accompany the disclosure of any position occupied by an object, or part of an object, have been, in the experiences of ourselves and our ancestors, oftener associated with the feelings accompanying disclosure of adjacent occupied positions than they have with the feelings accompanying the disclosure of remote positions. Obviously the frequency and directness of the associations have always been proportionate to the proximity. Hence, from the law of association it is an immediate corollary that when the eyes are converged on any point, we become clearly conscious of the space around it, and that when we turn the eyes to a second point this consciousness fades, and gives place to a similar

distinct consciousness of the space around this second point. No less significant is the concomitant peculiarity that while we are conscious of the space between our eyes and anything at which we look, we are not simultaneously conscious of the space beyond: unless it contains objects which are impressing their images upon us. This fact will be most clearly recognized on observing how at night, when the shutters are closed and no sound reminds us of the outer world, we have no distinctly-presented consciousness of outer space. We are spontaneously conscious of the space within the walls, but we are not spontaneously conscious of the space beyond the walls. And when imagination makes us conscious of this space beyond the walls, we become conscious of it by thinking of ourselves as looking at the objects it contains, and so remembering the spaces between us and them. Now this is manifestly just what the hypothesis implies. For the explorations which reveal the position of any object to us, are always explorations which acquaint us with the space between us and it, but not with the space beyond it.

The feelings accompanying certain abnormal states of the nervous system, furnish confirmatory evidence. De Quincey, describing some of his opium-dreams, says that "buildings and landscapes were exhibited in proportions so vast as the bodily eye is not fitted to receive. *Space swelled,* and was amplified to an extent of unutterable infinity." It is not at all an uncommon thing with nervous subjects to have illusive perceptions in which the body seems enormously extended: even to the covering an acre of ground. Now the state in which these phenomena occur, is one of exalted nervous activity—a state in which De Quincey depicts himself as seeing in their minutest details the long-forgotten events of his childhood. And if we consider what effect must be produced on the consciousness of space, by an excitement during which forgotten experiences are revived in extreme abundance and vividness, we shall see that it

will cause the illusion he names. Of the surrounding positions, in part potentially registered in the inherited organization and in part disclosed by the individual's actions, only some are present to consciousness at any instant. Memory, inherited and acquired, fails to bring back more than a small portion of the impressions received. Now imagine multitudes of the fading experiences suddenly to revive, and to become definitely present to consciousness. What must result? It must result that space will be known in comparatively microscopic detail. Within any portion of it, ordinarily thought of as containing a certain quantity of positions, a much greater quantity of positions will be thought of. Between the eye and each point looked at, whose distance is commonly conceived as equivalent to a certain series of positions, a far more extensive series will be conceived; and as the length of each such series is the mind's measure of the distance, all distances will appear increased, all points will appear more remote, and it will seem that space has "swelled," as De Quincey expresses it.

And now mark that while these several peculiarities in our space-perceptions harmonize with, and receive their interpretations from, the experience-hypothesis, taken in that expanded form implied by the doctrine of Evolution, they are not interpretable by, and are quite incongruous with, the Kantian hypothesis. Without insisting on the fact that our sensations of sound and odour do not originally carry with them the consciousness of space at all, there is the fact that along with those sensations of taste, touch, and sight which do carry this consciousness with them, it is carried in extremely different degrees—a fact quite unaccountable if space is given before all experience as a form of intuition. That our consciousness of adjacent space is far more complete than our consciousness of remote space, is also at variance with the hypothesis; which, for aught that appears to the contrary, implies homogeneity. Similarly with that variation in the distinctness of surrounding parts

of space which occurs as we turn our eyes now to one point and now to another : were space a subjective form not derived from experience, there should be no such variation. Again, the contrast between the spontaneous consciousness of space within a room, and the consciousness of the space beyond its walls, which does not come spontaneously, is a contrast for which there seems no reason if space is a fixed form. And so, too, that in morbid states space should appear "swelled," is, on the Kantian theory, unaccountable ; seeing that the *form* of intuition should remain constant, whether the intuition itself be normal or abnormal.

§ 334. Leaving here the inquiry concerning our perception of Space in its totality, a few further words are called for respecting that relation of two coexistent positions, in our consciousness of which the problem ultimately centres. From time to time in the progress of the argument, something has been done towards showing that it is an aggregate of simultaneous states of consciousness, symbolizing a series of states to which it is found equivalent. But, as before said, it is desirable to postpone the more definite analysis of this perception until the perception of motion is dealt with. At present the only reason for recurring to it, is to point out the indissoluble union between the cognition of space and the cognition of coexistence ; and afterwards to point out what is implied by this.

The idea of space involves the idea of coexistence, and the idea of coexistence involves the idea of space. On the one hand, space cannot be thought of without coexistent positions being thought of. On the other hand, coexistence cannot be thought of without at least two points in space being thought of. A relation of coexistence implies two somethings that coexist. Two somethings cannot occupy absolutely the same position in space. And hence coexistence implies space. If it be said that one body can have coexistent attributes, and that therefore two attributes can coexist

in the same place; the reply is, that body itself is unthinkable except as presenting coexistent positions—a top and a bottom, a right and a left. Body cannot be so diminished, even in imagination, as to present only one position. When it ceases to present in thought more than one position, it ceases to be body. And as attributes imply body—as a mere position in space can have no other attribute than that of position, it follows that a relation of coexistence, even between attributes, is inconceivable without an accompanying conception of space.

If now it should turn out that in the first stage of mental development a relation of coexistence is not directly cognizable, but is cognizable only by a duplex act of thought—only by a comparison of experiences, the theory of the transcendentalists will be finally disposed of. When it comes to be shown that the ultimate element into which the consciousness of space is decomposable—the relation of coexistence—can itself be gained only by experience; the utter untenableness of the Kantian doctrine will become manifest. That this will be so shown, the reader must at present take for granted. I am obliged thus to forestall the argument, because it would be inconvenient, during an analysis of the several orders of relations, to recur at any length to the controversy respecting space.

§ 335. To complete the chapter it needs but to say that the process of organic classification, shown in previous cases to constitute the act of perception, is very clearly exhibited in the perception of space.

The materials of the perception having been gained in the way described, the co-ordination of them into any particular perception consists in the assimilation of each relation of position to the like before-known relations. In every glance we cast around, the distinct consciousness of the distance of each thing looked at, and the nascent consciousnesses of the distances of various neighbouring things, alike imply class-

ings of present distances with remembered distances. These distances being one and all unknowable under any other condition, there is no alternative but to admit this. And the fact that numberless such classings should be simultaneously made by us without attracting our attention, simply shows to what perfection the process of automatic classification is brought by infinite repetition throughout the lives of all ancestral organisms, as throughout our own lives.

Since the two foregoing chapters have been stereotyped and in part printed, it has occurred to me that due attention has not been paid in them to those early stages in the development of the visual perception of space, which were indicated in the "Physical Synthesis." The cause of this inadequate attention has been that while revising these chapters (which were originally written before the synthetical divisions were fully thought out) the conceptions set forth in them have so far possessed me that I have overlooked some qualifications which should be made, in addition to those which have been made. These I now append.

In §§ 233–5 will be found a sketch of the process by which, in a creature having the general type and movements of a rudimentary fish, there may in course of time be established a structure of the kind required to co-ordinate its muscular motions with its visual impressions. On considering the implications of the argument running through those sections, it will be seen that we must infer the gradual rise of nervous connexions such that impressions received through the eyes from small objects before the creature, will produce, automatically, muscular movements such as will bring its head up to the objects. That is to say, within a certain region of space around and in front of the creature's head, the positions are in a sense known—known so far that the visual impression received from something occupying any one of them is correlated with the muscular tensions gone through in turning the body and moving the head up to this something. That correlations of this direct kind between visual impressions and muscular motions do exist, is proved by the actions of every fish from moment to moment. And that such correlations are inherited in the form of automatically-acting sets of nervous plexuses, is proved by the fact that they effectually guide the young fish while so undeveloped that it still carries the remains of a yelk-bag attached to its abdomen. Indeed, it is obvious, *à priori*, that if these correlations were not pre-established in its organization, the young fish could not

survive; since, in the absence of food supplied by a parent, it would starve before such correlations could be established by its own experiences—even supposing that its own experiences commencing *de novo* would suffice, which is a strong supposition. Thus, it is undeniable that quite early in the course of nervous evolution, there arises something which seems like a visual space-consciousness; that this arises without tactual explorations; and that it is mainly fixed in the inherited nervous structure.

But now let us not assume too much—let us not err by inferring the possession of a visual space-consciousness like our own. That inverse anthropomorphism by which we are continually led to interpret the actions of inferior animals in terms of human ideas and feelings, will mislead us here if we do not take care. It is natural to suppose that a rudimentary creature which, being impressed by an adjacent object, moves itself in the way required to lay hold of this object, must have a consciousness of position such as we have. Yet I believe it may be shown that between the two modes of consciousness there is an enormous difference. Let us look closely into the matter.

We are not warranted in crediting an animal with a higher type of consciousness than its actions imply. And supposing its actions are interpretable without further assumptions, we are not warranted in crediting it with a consciousness containing elements that have nothing corresponding to them in its own experiences or the experiences of its ancestry: this is a necessary implication of the Evolution-hypothesis. Hence in considering the nature of the space-consciousness described, we have to ask what are the elements given in the experiences which, as organized, constitute it. We shall find that they are limited almost entirely to experiences of successions. When a fish-like creature of the kind supposed, impressed by a small object before it on the right, so moves its tail as to bring the axis of its body into a line with the object; and when by lateral undulations of its body it brings its head up to the object; what are the changes undergone by its nervous centres? A series of re-actions accompanying the actions of the muscles, and a series of visual impressions; first limited to one eye, then joined in an imperfect way by the two eyes (for a fish's visual axes do not converge), and then forming a series the members of which, partially joined, become larger and stronger as the object is neared. The only approach to experiences of coexistence are the experiences of concurrence between the two series—the series of muscular tensions and the series of increasing visual impressions. But two concurrent series in Time, contain no such element as that of continuous coexistence, which forms the unit of consciousness of Space. To perceive, in the human sense, the locality of an object, is to be simultaneously conscious of the whole series of coexistent positions

lying between the subject and the object; and, as concluded in the foregoing chapter, this implies that these positions, first known in succession, have been simultaneously known through their occupancy by things simultaneously impressing us. How the primitive fish is guided by serial experiences only, will become conceivable on observing that the consciousness it has is analogous to the consciousness we should have if we were moved through dark space containing sounding bodies without being aware of our motion; for we should then know of an impending contact with a sounding body by the increasing loudness of the sound. Any difficulty that may be found in conceiving such a type of consciousness, will disappear on cross-examining a man born blind; and on finding that beyond the small portions of adjacent space which, when occupied by things, yield to his limbs simultaneous impressions, and so reveal coexistent positions, he has no consciousness of space, save in the successively-presented terms that accompany his movements through it. He finds his way partly by the sounds which, on previously going to a place, he heard in a certain order; partly by the successive touches which accompanied this series of sounds; and partly by the series of steps and accompanying estimate of time: the whereabouts of the place in remote space as we conceive it, is inconceivable by him. Even a square table he knows only in terms of the touches and tensions, partly simultaneous but mainly successive, accompanying exploration of it; and gets a crude idea of its squareness only when *told* that it is like a small square thing which he can grasp all at once. When we bear in mind that the congenitally-blind man inherits that complex nervous structure in which the human space-consciousness is latent, we shall see that even such dim notions as he can form of positions a little beyond the reach of his hands, are to be ascribed to the aid which this inherited structure gives him in eking out his tactual experiences; and that in the absence of this inherited structure, with all its reflex suggestions, he would know nothing of things in space save as occurring at certain places in the series of his conscious states. Now though it seems strange to illustrate the consciousness of a creature which can see but has no limbs with which to explore, by comparing it to the consciousness of one who can tactually explore but cannot see; yet the two are parallel thus far, that in both there are states of consciousness presented only in series, and that in the absence of any means by which such series can be presented simultaneously, there can arise no consciousness of the coexistent positions to which the serial positions are equivalent. We are helped to understand that a complete consciousness of occupied space can arise only when, by the motion of a limb over a surface, a series of muscular tensions joined with a series of tactual impressions yielded by the successive points touched, goes along with

a continuous visual impression received from all these points; and that a complete consciousness of unoccupied space can arise only when it is found that the serial tensions received from the moving limb, and the serial visual impressions received from it, can occur without any successive tactual impressions and without any simultaneous visual impressions from all the positions which previously yielded such tactual impressions.

There is good reason to think, therefore, that the consciousness of space is reached through a process of evolution, which begins with it in so rudimentary a state that it cannot properly be called a consciousness of space, in the sense we ordinarily give to the word; and that in the course of the evolution new elements are added, combinations between these and the primitive elements are formed, and the consciousness becomes more complex at the same time that it integrates and widens.

[The interpretation of the genesis of our Space-consciousness contained in the foregoing chapter, with its appended note, originally set forth in the first edition of this work, published in 1855, has since then gained some acceptance among psychologists of the naturalistic school, and has become current in Germany. At the same time it has aroused the antagonism of the transcendental school, and has, in various places, been attacked by the neo-Kantists. Preoccupations long prevented me from taking any notice of their criticisms, but I at length found it needful to deal with them; and, in the number of *Mind* for June 1890, singled out for reply the work of Prof. Watson, entitled *Kant and his English Critics.* To this reply I have thought it desirable to give a permanent place. It will be found in the Appendix.]

CHAPTER XV.

THE PERCEPTION OF TIME.

§ 336. The near relationship between our notion of Time and our notion of Space, is implied in current forms of speech. In the phrase "a great space of time," a magnitude of one serves to denote a magnitude of the other. Conversely, the tourist in Switzerland whose inquiries respecting distances are answered in *stunden*, or hours; and the savage who, in common with the ancient Hebrew, has a place described to him as so many days' journey off; find times used to express spaces. The like reciprocity of symbolism occurs in science. Beyond the facts that a second of time is a function of the length of the pendulum, and that our hours are measured by spaces on the dial, there is the fact that a degree, which was originally a day's journey of the Sun along the ecliptic, has become the name of an angular space.

Joined to the arguments contained in the last chapter, these facts possess much significance. *That in early ages, and in uncivilized countries, men should have expressed Space in terms of Time, and that afterwards, as a result of progress, they should have come to express Time in terms of Space;* is a circumstance giving strong support to the views recently developed. While it shows conclusively that the phenomena of coexistence and those of sequence, *are* made to stand for each other in the mind; it also shows,

repeated on a higher platform, that gradual supplanting of mental sequences by their equivalent coexistences, lately described as the process by which our cognition of Space is acquired. Just as we saw that the series of states of consciousness accompanying any motion, becomes consolidated into a quasi-single consciousness of the coexistent positions (or space) traversed during that motion, which single consciousness afterwards expresses to the mind the series it was equivalent to; so we see that the series of states of consciousness implied by "a day's journey," becomes consolidated into a consciousness of the coexistent positions traversed (measured by miles or leagues), which practically-single state of consciousness has supplanted in thought and word the series of states represented by it. Any one wishing yet further examples of this mental substitution, will find one on observing how habitually he thinks of the spaces on the clock-face instead of the periods they stand for—how, on discovering it to be half an hour later than he supposed, he does not represent the half-hour in its duration, but scarcely passes beyond the sign of it marked by the finger. Such illustrations make it easy to conceive that the use of coexistences to symbolize sequences, which in these complex cases has become so habitual, has in the simplest cases become organic.

This reciprocity between our cognitions of Space and Time, alike in their primitive and most developed forms, being understood; and the consequent impossibility of considering either of them entirely alone, being inferred; let us go on to deal more particularly with Time.

§ 337. As the notions of Space and Coexistence are inseparable, so are the notions of Time and Sequence. It is impossible to think of Time without thinking of some succession; and it is equally impossible to think of any succession without thinking of Time. Time, like Space, cannot be conceived except by the establishment of a relation between

at least two elements of consciousness: the difference being that while, in the case of Space, these two elements are, or seem to be, present together, in the case of Time they are not present together.

The doctrine that Time is knowable only by the succession of our mental states calls for little exposition: it is so well established a doctrine. All that seems here necessary, is to re-state it in a way which will bring out its harmony with the foregoing doctrines. To this end, it will be well first to recall the fact that the cognition is entirely relative. When treating of the "Relativity of Relations" (§ 91), it was pointed out that the apparent lengths of sequences vary with "the structure of the organism, with its size, with its age, with its constitutional state, with the number and vividness of the impressions it receives, and with their relative positions in consciousness."

Omitting, as not relevant to the present inquiry, those causes of variation that go along with difference of species, we may say that our notion of any period of time, is determined by the length of the series of remembered states of consciousness experienced during that time. I say advisedly *remembered* states of consciousness. For as any series of states of consciousness can be known only by memory; and as any of the states that have occurred but are not represented in memory cannot be components of the series; it results that the series of remembered states can alone serve as the measure between a past and a present state. And hence the explanation of all such facts as that an interval looked back upon by a child, appears longer than the same interval looked back upon by an adult; since, out of the same series of experiences, many which being novel to the child make deep impressions on it, are so familiar to the adult as to make scarcely any impressions. And the length of the series of remembered states of consciousness being thus our measure of time, we have no longer any difficulty in understanding cases in which vivid ideas, following each

other with extreme rapidity, cause a night to seem like a hundred years, or, as in some drowning persons, a few minutes to represent a whole life.

When, however, we say that the time between two events is recognized by the series of remembered states of consciousness intervening, what do we more specifically mean? These two events were known to us by the states of consciousness they produced. Before the first of these there were countless other states of consciousness. Since the last of them there have been others. Between them there were others. We know them, therefore, as having certain *places* in the whole series of states of consciousness experienced during our lives. The time at which each occurred is known to us as its *position* in the series. And by the time between them, we mean their *relative positions* in the series. As any relation of coexistent positions—any portion of space, is conceived by us as such or such, according to the number of other positions that intervene; so, any relation of sequent positions—any portion of time, is conceived by us as such or such, according to the number of other positions that intervene. Thus, a particular time is a relation of position between some two states in the series of states of consciousness. And Time in general, as known to us, is *the abstract of all relations of position among successive states of consciousness.* Or, using other words, we may say that it is *the blank form in which these successive states are presented and represented; and which, serving alike for each, is not dependent on any.*

For here we have to note the fact, parallel to a fact noted when treating of Space, that since in the series of our states of consciousness the same positions, as estimated by their distances from the state that is passing, have been occupied by states of all kinds, these positions become known apart from states of each particular kind. If at a certain distance back in the train of my thoughts, there was always a feeling of colour, there would be an

established association between that place and that feeling. But as this same place is now filled by a tactual sensation, now by an auditory sensation, and now by a sensation coming from the palate, or the nostrils, or the viscera; it results that the place is dissociated from special sensations and from special kinds of sensations. And the same thing having happened with every other place, known as nearer or more remote, the whole series of these places, considered as separate from the feelings that may be in them, or as unoccupied by feelings, comes to be aggregated into a consciousness of Time, considered as the blank form of all relations of sequence; just as we saw that there similarly arises the consciousness of Space, as the blank form of all relations of coexistence.

§ 338. By defenders of the Kantian hypothesis, it will probably be contended that the consciousness of Time is given along with the first sequence experienced, which cannot otherwise be known as a sequence. I reply that it is not at first known as a sequence; and that the full consciousness of it as a sequence, and of Time as its form, arise through the same accumulated experiences.

It is, doubtless, to be concluded that even in a nascent consciousness the successive states must be severally recognized as standing to one another in certain relations of position—either as occurring next to one another, or as separated by intervening states. Though, at first, probably no considerable portion of the series of states can be contemplated at once, and no *distant* members of it brought into relation, yet the simplest cognition implies that sundry of the *proximate* members of it are co-ordinated and their respective places known in some vague way. But neither the contemplation of any two states of consciousness that stand in certain relative positions, nor the thinking of their relation of position as like some other relation of position, gives, in itself, the notion of Time; although it is the raw material

out of which that notion is constructed. Time, as conceived by us, is not any one relation of position in the series; nor any relation between two such relations; but is the abstract of all such relations, and cannot possibly be conceived until many of them have been known and compared. To elucidate this let us consider a parallel case. Suppose an incipient intelligence to receive two equal impressions of the colour red. No other experiences having been received, the *relation* between these two impressions cannot be thought of in any way; because there exists no other relation with which it can be classed, or from which it can be distinguished. Suppose two other equal impressions of red are received. There can still exist no idea of the relation between them. For though there is a repetition of the previously-experienced relation, yet since no thing can be cognized save as of some kind; and since, by its very nature, kind implies the establishment of difference; there cannot, while only one order of relation has been experienced, be any knowledge of it—any thought about it. Now suppose that two unequal impressions of red are received. There is experienced a second species of relation. And if there are afterwards presented many such pairs of impressions, the members of which are severally equal and unequal, it becomes possible for the constituents of each new pair to be vaguely thought of as like or unlike, and as standing in relations like or unlike previous ones. I say vaguely thought of, because, while various impressions of the colour red are the sole things known, the cognitions of their likenesses and unlikenesses will not be distinctly separable from the impressions themselves. When, however, pairs of impressions belonging to some other species come to be received—as of the colour green in different intensities—the occurrence among these also of some that are like and of others that are unlike, will tend to dissociate these relations from the colours green and red. And gradually as, by accumulation of experiences, there are found

to be like and unlike sounds, tastes, smells, resistances, temperatures, &c., the relationships which we signify by these words like and unlike, will become partially separable in thought from particular impressions: the ideas of *likeness* and *unlikeness* will begin to arise, and will become more distinct and more abstract in proportion to the multiplicity of kinds of impressions presenting them. Manifestly, then, the ideas of likeness and unlikeness are impossible until after multitudes of things have been thought of as like and unlike. Similarly in the case before us. After various relations of position among states of consciousness have been contemplated, have been compared, have become familiar; and after the experiences of different relations of position have been so accumulated as to dissociate the idea of the relation from all particular positions; then, but not till then, can there arise that abstract notion of *relativity of position* among successive states of consciousness which constitutes the notion of their several places in time, and that abstract notion of *aggregated relative positions* which constitutes the notion of Time in general.

§ 339. How far the consciousness of Time is, in its general character, fixed by the inherited structure in a way like that in which the consciousness of Space is fixed, is an interesting question. That there is some kind of pre-determination we may feel tolerably certain; while we may suspect the pre-determination to be less specific than that to which we here compare it.

When treating of the "Relativity of Relations," (§ 91), it was pointed out that the consciousness of Time must vary with size, with structure, and with functional activity; since the scale of time proper to each creature is composed primarily of the marks made in its consciousness by the rhythms of its vital functions, and secondarily of the marks made in its consciousness by the rhythms of its locomotive functions: both which sets of rhythms are immensely

different in different species. Consequently, the constitution derived from ancestry settles the general character of the consciousness within approximate limits. In our own case, for example, it is clear that there are certain extremes within which our units of measure for time must fall. The heart-beats and respiratory actions serving as primitive measures, can have their rates varied within moderate ranges only. The alternating movements of the legs have a certain degree of slowness below which we cannot be conscious of them, and a certain degree of rapidity beyond which we cannot push them. Similarly with measures of time furnished by sensible motions outside of us. There are motions too rapid for our perceptions, as well as motions too slow for our perceptions; and such consciousness of time as we get from watching objective motions must fall between these extremes.

To what extent the larger consciousness of Time is predetermined, and to what extent it is determined by individual experiences, are also points about which nothing very definite can be said. Still, we may see grounds for concluding that the lengths of the periods over which consciousness can range in such way as to grasp them, are approximately limited by inherited nervous structures. For the power to estimate an interval of hours or days depends on the power to represent the events that have occurred during its lapse. The inability of an old person to remember what he was doing two days ago, shows us that as fast as the series of impressions lately received becomes less easily representable, the estimation of recent long intervals becomes impracticable. This case, which illustrates the result of defective function, I cite merely to indicate the connexion between consciousness of time and faculty of representation. And having done this, it remains only to point out that since structure is the primary condition to representation (in so far that with a given degree of structure there cannot be more than a given amount of representation), it follows that

the consciousness of time in its wider reach must be potentially fixed in its general character by the organization.

§ 340. Such being the genesis and nature of our consciousness of Time, considered generally, we have but further to ask in what consists the process of perceiving a time.

Strictly speaking, perception here passes very nearly into conception. For while in perception as commonly exemplified, many or most of the components of the consciousness are presented while some are represented, in the perception of a portion of time, nearly all the components are represented: only the passing feelings are given in vivid forms, and all the rest are given in their faint forms. But making this qualification, it only needs to say respecting the perception of a portion of time, that it consists in the classing of the relation of serial positions contemplated as forming it, with certain before-known relations—the cognition of it as like such before-known relations.

CHAPTER XVI.

THE PERCEPTION OF MOTION.

§ 241. As shown by the foregoing discussions, our ideas of Motion, Time, and Space, are so intimately connected that it is extremely difficult to disentangle them. On the one hand it has, I think, been made clear that Space and Time are knowable only through Motion. On the other hand it is by some contended, with great apparent truth, that Motion is unknowable except as in Space and Time; and that, therefore, notions of Space and Time must pre-exist. Taking which two positions together, there seems no course left but to adopt the Kantian hypothesis; and conclude that Time and Space are forms of sensibility which are disclosed in the act by which Motion is perceived. A closer consideration, however, will show that there is an alternative.

For though the consciousness of Motion cannot be formed by the developed mind, without an accompanying consciousness of Space and Time; it does not follow that the consciousness of Motion in the *un*developed mind is similarly accompanied. It does not follow that because the connexion between the notions is now indissoluble, it was always so. The confusion has arisen from the unwarrantable assumption, that certain impressions received through the senses were originally understood in a way just like that in which they are understood after the accu-

mulation of multitudinous experiences—an assumption at variance with the established facts of Psychology. Do we not know that the form of a house is comprehended by the child, after a manner in which the infant cannot comprehend it? Do we not know that the daily rising and setting of the sun, are thought of in completely different ways by a savage and by an astronomer? Do we not know that the physicist thinks of sound, or of light, or of heat, in a manner utterly unlike that in which the clown thinks of them? Moreover, is it not admitted that much of our acquired knowledge becomes so consolidated as to disable us from dissociating its elements—that on grasping an apple we cannot, without great difficulty, so confine our consciousness to the sensations of touch as to avoid thinking of the apple as spherical—that we find it impossible, when looking at a neighbouring object, to shut out all thought of the distance and attend only to the visual sensations? And when we unite these two general facts, that by combining its experiences the mind acquires conceptions quite different from those it originally had, and that such of these as are invariably combined, and perpetually combined, become fused into conceptions that are undecomposable by introspection; does it not become manifest, both that the idea of Motion which accompanies developed intelligence is distinct in nature from the idea of Motion which undeveloped intelligence frames, and that it has become impossible for the one to think of Motion as the other thought of it? It is a vicious assumption that what are necessities of thought to us, are necessities of thought in the abstract.

"But how," it may be asked, "is it possible for us to deal with Motion as known in some form different from that in which we know it? How are we to treat of a conception which we cannot ourselves have?" Very readily. For though in our adult consciousness of Motion the ideas of Space and Time are inextricably involved, there is another element in that consciousness which we may see

would remain were the ideas of Space and Time absent. Though on moving my arm, even in the dark, I cannot become conscious of the motion without being simultaneously conscious of a space traversed and a time occupied in traversing it; yet it is obvious to me that the muscular sensations accompanying the motion, are quite distinct in nature from the notions of Space and Time associated with them. I find no difficulty in so far isolating these sensations, as to perceive that the consciousness of them would remain were my notions of Space and Time abolished. And I find no difficulty in conceiving that Motion is thinkable by a nascent intelligence as consisting of these sensations, while yet the notions of Space and Time are undeveloped.

Seeing, then, that the primitive consciousness of Motion may readily be conceived to have contained but one of the elements ultimately included in it, we may properly inquire whether, out of such a primitive consciousness of Motion, the consciousness we have of it may be evolved.

§ 342. To open this inquiry systematically, let us first look at the data furnished by preceding chapters.

We saw that our consciousness of Space is an abstract of all relations among coexistent positions; that the germinal element of the consciousness is the relation between two coexistent positions; that every relation between two coexistent positions is resolvable into a relation of coexistent positions between the subject and an object touched; that this relation of coexistent positions between subject and object, is equivalent to the relation of coexistent positions between two parts of the body when adjusted by the muscles to a particular attitude; and that thus the question—How do we come by our cognition of Space? is reducible to the question—How do we discover the relation of coexistent positions between two sentient points on our surface?

Our consciousness of Time we saw to be the abstract of

all relations among successive positions in the series of our states of consciousness. We saw that the germinal element out of which this conception is developed, is a relation of position between two states of consciousness; and that every relation of position between two states of consciousness is known by the number of remembered intervening states.

Respecting Motion, we know that as through it only are changes in consciousness originally produced, through it only can relations of position among successive states of consciousness be disclosed; and that, for the same reason, through it only can be disclosed the relations of position among coexistences. At the same time we know that whether Motion is or is not originally cognizable in any other way, it is from the beginning cognizable through the changes of consciousness it produces. If it be a subjective motion, as that of a limb, it is present to the mind as a continuous but varying series of sensations of muscular tension. If it be an objective motion, as that of something traversing the surface of the body, or as that of something passing before the eyes, it is still present to the mind as a continuous series of sensations: in the one case the sensations that result from touching a succession of points on the skin; in the other case the sensations that result from exciting a succession of points on the retina. And if the motion be both subjective and objective, as when one part of the body is drawn over another part, or as when a limb is extended within view of the eyes, then it is present to the mind as a double series of sensations: in the one case, as a series of muscular sensations joined with a simultaneous series of tactual sensations; in the other case, as a series of muscular sensations joined with a simultaneous series of visual sensations. Finally, when the hand is moved over the body within view of the eyes, motion is present to the mind as a triple series of sensations—muscular, tactual, visual—occurring simultaneously.

Passing over for the present the visual phenomena, let us deal with the question in which centres the whole controversy respecting the genesis of our ideas of Motion, Space, and Time: the question, namely—How do we become cognizant of the relative positions of two points on the surface of the body? Such two points considered as coexistent, involve the germinal idea of Space. Such two points disclosed to consciousness by two successive tactual sensations, involve the germinal idea of Time. And the muscular sensations by which, when self-produced, these two tactual sensations are separated, involve the germinal idea of Motion. The questions to be considered then, are—In what order do these germinal ideas arise? and—How are they developed?

§ 343. Already, in treating of visible extension (§ 327), and the visual perception of space (§ 331), and in showing how serial states of consciousness are consolidated into simultaneous states which become their equivalents, the way has been prepared for answering these questions. The process of analysis partially applied to retinal impressions, has now to be applied, after a more complete manner, to impressions on the body at large.

To this end, taking for our subject a partially-developed creature, having a nervous structure that is able to receive the data for the cognition, but in which the data are not yet co-ordinated, let us call the two points on its body between which a relation is to be established, A and Z.* Let us

* In the first edition I had here set out with a newly-born infant: thus implying that the organization of experiences to be explained, occurs in the course of an individual life. The "Special Analysis" having been originally written before the "Special Synthesis," (as their order in the first edition shows), its conclusions were not worked out into full harmony with those which the Evolution-hypothesis led me to in the "Special Synthesis." As the revised argument of the foregoing chapters has made manifest, however, we must recognize these relations now to be dealt with, as potentially established in the nervous structure inherited by the infant. The intra-

assume these two points to be anywhere within reach of the limbs. By the hypothesis, nothing is at present known of these points; either as coexisting in Space, as giving successive sensations in Time, or as being brought into relation by Motion. If now the creature moves a limb in such a way as to touch nothing, there is a certain vague reaction upon its consciousness—a sensation of muscular tension. This sensation has the peculiarity of being indefinite in its commencement, indefinite in its termination, and indefinite in all its intermediate changes. Its strength being proportionate to the degree of contraction, it follows that as the limb starts from a state in which there is no contraction, and as it can reach a position requiring extreme contraction only by passing through positions requiring intermediate degrees of contraction, and as the degree of contraction must therefore form a series ascending by small increments from zero, the sensations of tension must also form such a series. And the sensations accompanying all subsequent movements must similarly form series that either increase or decrease; since a muscle cannot pass from any one state to any other without going through all the intermediate states. Thus, then, the creature, on moving its limb backwards and forwards without touching anything, has a consciousness not definitely divisible into states; but a consciousness the variations of which pass insensibly into one another, like undulations of greater or less magnitude. Manifestly, such a consciousness is but a nascent

uterine modifications it has gone through, have already repeated in a short time, those modifications slowly produced by the experiences of ancestral races during an immeasurable time. But the argument remains in essence the same, whether we conceive the progressive changes to be wrought in a long series of individuals which successively bequeath the modifications produced by experience, or whether we conceive them to be wrought in a continuously-existing individual. The partially-developed creature assumed above, must therefore be understood as a continuously-existing individual, or else as receiving in the course of its life such modifications as are ordinarily received only during the lives of species and genera and orders.

consciousness. While its states are thus indistinctly separated, there can be no clear comparison of them; no classing of them; no thought, properly so called; and consequently, no ideas of Motion, Time, or Space, as we understand them. Suppose that the limb touches something. A sudden change in consciousness is produced —a change that is incisive in its commencement, and, when the limb is removed, equally incisive in its termination. In the midst of the continuous feeling of muscular tension, vaguely rising and falling in intensity, there all at once occurs a distinct feeling of another kind. This feeling, beginning and ending abruptly, constitutes a definite state of consciousness; and becomes, as it were, a *mark* in consciousness. Other such marks are produced by other such acts; and in proportion as they are multiplied there arises a possibility of comparing them, both in respect to their strengths and in respect to their relative positions. At the same time the feelings of muscular tension being, as it were, divided into lengths by these super-posed marks, become similarly comparable; and so there are acquired materials for a simple order of thought. Observe, also, that while these tactual sensations may, when several things are touched in succession, produce successive marks in consciousness, separated by intervening muscular sensations, they may also become concurrent with these muscular sensations; as when the end of the limb is drawn along a surface. And observe further, that when the surface over which the end of the limb is drawn is not a foreign body, but some part of the creature's own body, these muscular sensations, and the continuous tactual sensation joined with them, are accompanied by a series of tactual sensations proceeding from that part of the skin over which the limb is drawn.

See then what happens and what is implied. When the creature moves the end of a limb along the surface of its body from A to Z, there are simultaneously impressed on

its consciousness three sets of sensations—the varying series of sensations proceeding from the muscles in action; the series of tactual sensations proceeding from the points of the skin successively touched between A and Z; and the continuous sensation of touch from the end of the limb. Now it might be argued that some progress is made towards the notion of space, in the simultaneous reception of these sensations—in the contemplation of them as coexistent; seeing that the notion of coexistence and the notion of space have a common root, or, in other words—seeing that to be conscious of a duality or multiplicity of sensations, is the first step towards being conscious of that duality or multiplicity of points in space which they imply. It might also be argued that as, when the limb is moved back from Z to A, the serial sensations occur in a reverse order, there is thus achieved a further step in the genesis of the notion; since coexistent things are alone capable of impressing consciousness in any order with equal vividness. But merely indicating these considerations, let us pass to the essential consideration. Every subsequent motion of the limb over the surface from A to Z results in the like simultaneous sets of sensations; and hence these, in course of time, become indissolubly associated. Though the series of tactual sensations, A to Z, being producible by a foreign body moving over the same surface, can be dissociated from the others; and though, if this surface (which we will suppose to be on the head) be withdrawn by a movement of the head, the same motion of the limb with its accompanying muscular sensations, may occur without any sensation of touch; yet when these two series are linked by the tactual sensation proceeding from the end of the limb, they necessarily proceed together, and become inseparably connected in thought. Consequently, the series of tactual sensations A to Z, and the series of muscular sensations which invariably accompanies it when self-produced, serve as equivalents; and being two sides of the same experience,

suggest each other in consciousness. *The successive feelings on the skin being excited, association brings up ideas of the habitually-correlated feelings in the limb; and the feelings in the limb being excited, association brings up ideas of the habitually-correlated feelings on the skin.* Due attention having been paid to this fact, let us go on to consider what must happen when something touches, at the same moment, the entire surface between A and Z. This surface is supplied by a series of independent nerve-fibres, each of which separately is affected by an impression falling within a specific area of the skin, and each of which produces a separate state of consciousness. When the finger is drawn along this surface, these nerve-fibres A, B, C, D, . . . Z, are excited in succession; that is—produce successive states of consciousness. But when something covers the whole surface between A and Z, they are excited simultaneously; and produce what tends to become a single state of consciousness. Already in a parallel case (§ 331) I have explained how, when impressions originally known as coming one after another come all at once, their sequent positions are transformed into coexistent positions, which, when consolidated by frequent presentation, are used in thought as equivalent to the sequent positions; and it is needless here to repeat the explanation. What it now concerns us to notice is this:—*that as the series of tactual feelings* A *to* Z, *known as having sequent positions in consciousness, is found to be equivalent to the accompanying series of muscular feelings; and as it is also found to be equivalent to the simultaneous tactual feelings* A *to* Z, *which are presented in coexistent positions; it follows that these two last are found to be equivalents to each other.* A series of muscular sensations becomes known as corresponding to a series of coexistent positions; and being habitually joined with it, becomes at last unthinkable without it. Thus, the relation of coexistent positions between the points A and Z (and by implication all inter-

mediate points), is necessarily disclosed by a comparison of experiences: the ideas of Space, Time, and Motion, are evolved together. When the successive states of consciousness A to Z, are thought of as having relative positions, the notion of Time becomes nascent. When these states of consciousness occur simultaneously, their relative positions, which were before sequent, become coexistent; and there arises a nascent consciousness of Space. And when these two relations of coexistent and sequent positions are both presented to consciousness along with a series of sensations of muscular tension, a nascent idea of Motion results.

The development of these nascent ideas by further accumulation and comparison of experiences, will be readily understood. What has been described as taking place with respect to one relation of coexistent positions, or rather, one linear series of such positions, is, during the same period, taking place with respect to countless other such linear series in all directions over the body. The like equivalence between a series of coexistent impressions of touch, a series of successive impressions of touch, and series of successive muscular impressions, is being established between every pair of points that can readily be brought into relation by movements of the limbs.

§ 344. But now a criticism has to be met and a qualification to be made. Exposition of the involved process we are dealing with, cannot be so carried on as to keep all parts of the process simultaneously in view; and, for simplicity's sake, I have described the development of this triple consciousness of Motion, Time, and Space, as though some elements of it were fully organized before the rest, and independently of them. The truth is, however, that the three notions are evolved concurrently — the development of certain components preceding by a little the development of other components.

For, careful study of the matter makes it manifest that if

we set out with a surface of skin supplied with the nerve-fibres required for yielding to consciousness all the separate tactual feelings A to Z, we assume much that has to be explained. The pre-existence of these several independent nerve-fibres and of the several independent central elements connected with them, which on being excited through them yield to consciousness states that are distinguishable from one another, is, in fact, the pre-existence of a potential consciousness of the positions A to Z—a consciousness so far potential that anything touching simultaneously the whole surface A to Z, produces the consciousness of these positions as coexistent. Hence the questions immediately arise—How came there to be this series of nerve-fibres having separate peripheral and central terminations? And is not the whole explanation begged when the pre-existence of such structures is taken for granted?

To these questions I answer that the process of genesis is carried on after a manner like that by which processes of organic genesis in general are carried on; namely, by reciprocal aid—by an action and reaction such that each increment of development in one agency makes possible increments of development in other agencies. Were we to describe the evolution of the digestive system, the vascular system, and the respiratory system, in a way which made it appear that the stomach having arisen there then arose a heart for the distribution of the absorbed nutriment, and that there then arose lungs serving to purify this nutriment; we should, by placing the facts in this simple serial order, greatly misrepresent the course of evolution. There is, throughout, an inter-dependence such that superior digestive organs cannot be formed in the absence of superior organs for circulating and aërating the blood; and such that a development of the circulatory organs is not possible in the absence of respiratory organs which are considerably developed. Nevertheless, while this mutual assistance is indispensable, it remains true that these functions make one

another possible in the order named. Until there is a supply of absorbed nutriment, organs for distributing it can have no function; and until there are organs for distributing it, organs for aërating it can have no function. In the course of their evolution absorption must go before circulation, and circulation before respiration; but this order being maintained, their evolution advances *pari passu*. Similarly with the processes we are considering. We have to recognize them as instrumental to one another in so far that no one can advance independently; and yet we have to recognize them as preserving a relation such that the first must make a step before there can be a step of the second, and the second must make a step before there can be a step of the third. Or, to speak definitely, the structures through which are given to consciousness separate impressions from adjacent parts of the skin, must develop a stage before there can be a further stage of development in the structures through which is gained the consciousness of these positions as tactually and muscularly disclosed in succession by the motion of a limb over them; and both must develop a stage before there can be a further development in structures through which is gained the consciousness of these positions as coexistent, and as having their distance known in terms of the successive tactual and muscular feelings that accompany transit from one to other.

Thus, then, we have so far to modify the foregoing explanations as to conceive the triple consciousnesss of Motion, Time, and Space, to be undergoing evolution along with evolution of the body in general—the evolution of bulk whereby it acquires an extended surface, having more numerous separate portions capable of having separate nerve-fibres; the evolution of structure whereby limbs are developed and acquire greater and more varied capacities for motion and locomotion; and the evolution of nerves and nerve-centres which is the concomitant of these evolutions

We have to regard the perpetual converse of the organism with its environment, and of its parts with one another by mutual explorations, as building up this triple consciousness, element by element; as the nervous system itself is built up, fibre by fibre and cell by cell. And we have to regard each new structural unit of any order, with the accompanying functional unit of consciousness which it yields, as no sooner established than it begins to co-operate in producing new units of the other orders.

Certain physiological experiments yield strong support to the belief that this mutual exploration by surfaces of the body, itself aids the multiplication of separate sentient areas, at the same time that it develops the consciousness of their relations. The facts ascertained by Weber imply that the degree of tactual discrimination in any part, is not so much proportionate to the multiplied contacts of the part with surrounding objects, as it is proportionate to the exposure of the part itself to habitual exploration by other parts. Thus, the surface of the face, which is not at all used for tactually examining things, has nevertheless much capacity for distinguishing relative positions. The cheek has as great a perceptive power as the palm of the hand, and the lower part of the forehead has a greater perceptive power than the back of the hand: the interpretation being that there is a continual converse between the hands and the face. To see that this is the reason, we have but to observe that the middle of the fore-arm, the middle of the thigh, the middle of the back of the neck, and the middle of the back, which are surfaces least explored by the hands, have only one-sixth of the tactual discrimination possessed by the cheek—a fact quite inexplicable teleologically. Hence, then, we have an inductive basis for the belief that as in the fingers of a blind man accustomed to read raised characters, there goes on that multiplication of nerve-fibres implied by the increased perceptiveness; so, in the course of general evolution, there goes on in any surface a multiplication of nerve-

fibres proportionate to the multiplicity of separate touches, whether produced by the exploration of other things or by self-exploration; and that where it results from self-exploration, there also go on the above-described concomitant developments.

We have now only to glance at one or two general corollaries from these interpretations.

§ 345. Besides the establishment of a connexion in thought between each *particular* muscular series and the *particular* tactual series, both successive and simultaneous, with which it is associated in act; and besides the implied establishment of a knowledge of the special muscular adjustments required to touch each special part; there must be a still more decided establishment of a connexion between muscular series in general and series of sequent and coexistent positions in general; since this connexion is repeated in every one of the particular experiences. And when we consider the infinite repetition of these experiences, we shall have no difficulty in understanding how their components become so consolidated, that even when the hand is moved in the dark without touching anything, it is impossible to be conscious of the muscular sensations without being conscious of the sequent and coexistent positions—the Time and Space—in which it has moved.

Observe again, that as, by this continuous exploration each point on the skin is put in relation with multitudinous points that lie not in one direction only but in all directions, it follows that when an object of some size is placed on the skin, the impressions from all parts of the area covered being simultaneously presented to consciousness, occupy coexistent positions before consciousness: whence results an idea of the superficial extension of that part of the body. The idea of this extension is really nothing more than a simultaneous presentation of all the impressions proceeding from the various points it includes, which

have previously had their several relative positions measured by means of the series of impressions separating them. Any one who hesitates respecting this conclusion, will, I think, adopt it, on critically considering the perception he has when placing a book against his cheek—on observing that the perception is made up of many elements which he cannot think of all together—on observing that there is always one part of the whole surface touched, of which he is more distinctly conscious than of any other part—and on observing that to become fully conscious of any other part, he has to traverse in thought the intervening parts; that is, he has to think of the relative positions of these parts by vaguely recalling the series of states of consciousness which a motion over the skin from one to the other would involve.

It is needless now to dwell on that development of these fundamental ideas which results when the visual experiences are united with the tactual and muscular experiences. Being merely a further complication of the same process, it may readily be traced out by joining with the above explanations, those given when treating of visible extension and space. Here I need only add that, by serving clearly to establish in our minds the identity of subjective and objective motion, sight enables us to dissociate Motion almost entirely from those muscular sensations through which it is primarily known to us; and that by doing this, and by so reducing our idea of Motion to that of coexistent positions in Space occupied in successive positions in Time, it produces the apparently necessary connexion between these three ideas.

§ 346. We conclude, then, that the consciousness of Motion, originally present under the form of a series of muscular sensations, serves by its union with tactual experiences to disclose Time and Space to us; and that, in the act of disclosing them, it becomes clothed with the ideas of them, and ultimately becomes inconceivable without these ideas.

It remains to say that the perception of Motion, as we know it, consists in the establishment in consciousness of a relation of simultaneity between two relations—a relation of coexistent positions in Space, and a relation of sequent positions in Time (with which, however, there necessarily goes the consciousness of a something that occupies these positions successively). And in the act of perception, these jointly-presented relations are severally assimilated to the like relations before known. Thus the perception of great velocity is possible only by simultaneously thinking of two coexistent positions as *remote*, and two sequent positions as *near*: which words remote and near, imply the classing of the two relations with previously-experienced ones. And similarly with perceptions of the kind of motion, and the direction of motion.

CHAPTER XVII.

THE PERCEPTION OF RESISTANCE.

§ 347. We may conclude, *à priori*, that of the various impressions received by consciousness, there must be some most general impression. The building up of our experiences into a complex structure, implies a fundamental experience on which the structure may rest. By successive decompositions of our knowledge into simpler and simpler components, we must come at last to the simplest—to the ultimate material—to the substratum. What is this substratum? It is the impression of resistance. This is the primordial, the universal, the ever-present constituent of consciousness.

It is primordial in the sense that it is an impression of which the lowest orders of creatures show themselves susceptible, and in the sense that it is the first species of impression received by the highest creatures: it is appreciated by the nerveless tissue of the zoophyte, and is presented in a vague manner even to the nascent consciousness of the unborn child.

It is universal, both as being cognizable (using that word not in the human but in a wider sense) by every creature possessing any sensitiveness, and usually as being cognizable by all parts of the body of each—both as being common to all sensitive organisms, and mostly as being common in greater or less degrees to their entire surfaces.

It is ever present, inasmuch as every creature, or at any rate every terrestrial creature, is subject to it during the whole of its existence. Excluding those lowest animals which make no visible response to external stimuli, and those which float passively suspended in the water, there are none but what have, at every moment of their lives, some impressions of resistance; proceeding either from the surfaces on which they rest, or from the reactions of their members during locomotion, or from both.

Thus, impressions of resistance as being the earliest that are appreciated by the sensitive creation regarded as a progressive whole, as well as by every higher animal in the course of its evolution; and as being more or less appreciated by all parts of the body in the great majority of animals; are necessarily the first materials put together in the genesis of intelligence. And as being the impressions continuously present in one form or other throughout life, they necessarily constitute that thread of consciousness on which all other impressions are strung—form, as it were, the weft of that tissue of thought which we are ever weaving.

But leaving general statements, let us go on to consider these truths somewhat in detail.

§ 348. That our perception of Body has for its ultimate elements impressions of resistance, is a conclusion to which all the foregoing analyses point. In the order of thought (and of any other order we can know nothing) resistance is the primary attribute of body; and extension is a secondary attribute. Here is the evidence.

We know extension only through a combination of resistances. We know resistance immediately by itself; for though to a developed intelligence the consciousness of position is given along with the consciousness of resistance, it is clear that were the consciousness of position absent this would not involve the absence of the consciousness of resistance. Again, a thing

cannot be thought of as occupying space, except as offering resistance. Even though but a point, if it be conceived to offer absolutely *no* resistance, it ceases to be anything—becomes *no*-thing. Resistance is that by which occupied extension (body) and empty extension (space) are differentiated. And the primary property of body, considered as a different thing from not-body, must be that by which it is universally distinguished from not-body: namely, resistance. Moreover, it is by resistance we determine whether any appearance is body or not. Resistance without appearance we decide to be body; as when striking against any object in the dark. Appearance without resistance we decide not to be body; as in the case of optical illusions. Once more there is a thing which we know to be body *only* by its resistance; namely, air. We should be ignorant that there is such a thing as air, were it not for its resistance; and we endow it with extension by an act of inference. So that, not only is body primarily known as resistant, and subsequently, through a combination of resistances, is known as occupying space; but the kind of body we call gaseous presents to our senses no other attribute than that of resistance.

That our cognition of Space can arise only through an interpretation of resistances, is a corollary from preceding chapters. The ultimate element into which our notion of Space is resolvable, was shown to be the relation between two coexistent positions. And that such two coexistent positions may be presented to consciousness, it is necessary that they should be occupied by things capable of impressing us; that is—by resistant things. Space in itself, having no sensible properties, would be for ever unknowable to us did it not contain objects. Even Kantists do not contend that it is knowable by itself; but say that our experiences of things are the *occasions* of its disclosure to us. And as all our experiences of things are ultimately resolvable into either resistances or the signs of resistances,

it follows that on any hypothesis, Space is cognizable only through experience of resistances.

Similarly with Motion. As was shown in the last chapter, subjective motion is primarily known as a varying series of states of muscular tension, that is—sensations of resistance. The series of tactual sensations through which it is also known when one part of the body is drawn over another, are sensations produced by something that resists. And the objective motion recognized by sight, is fully understood only when it is recognized as equivalent to the subjective motion known through the muscular and visual sensations conjoined; as when we move our own limbs within view of the eyes. So that the developed consciousness of motion grows out of a consciousness of a certain order of resistances.

Our notion of Force, also, has a parallel genesis. Resistance, as known subjectively in our sensations of muscular tension, forms the substance of our consciousness of force. That we have such a consciousness, is a fact which no metaphysical quibbling can set aside. That we must think of force in terms of our experience—must construct our conception of it out of the sensations we have received, is also beyond question. That we have never had, and never can have, any experience of the force by which objects produce changes in other objects, is equally indisputable. And that, therefore, our notion of force is a generalization of those muscular sensations which we have when we are ourselves the producers of changes in outward things, is an unavoidable corollary. How force as so conceived is afterwards inevitably ascribed to all external workers of change, is easy to see. Every one experiences the same sensible effects when body strikes against him, as when he strikes against body. Hence he is obliged to represent to himself the action of body upon him as like his action upon it. And the sensible antecedent of his action upon body being the feeling of muscular tension, he cannot conceive its

action upon himself as of like nature, without vaguely thinking of this muscular tension, that is, of force, as the antecedent of its action.

Thus, Matter, Space, Motion, Force—all our fundamental ideas, arise by generalization and abstraction from our experiences of resistance. Nor shall we see in this anything strange if we contemplate, under its simplest aspect, the relation between the organism and its environment. Here is a subject placed in the midst of objects. It can learn nothing of them without being affected by them. Being affected by them implies their action upon its surface. Their action must be either action by direct contact, or action through some intermediate agency. In virtue of the law of gravitation, their primary and continuous action is by direct contact. In the nature of things, also, their all-important actions, both destructive and preservative—through enemies and through food—are by direct contact. Hence, action by direct contact being the primary action, the unceasing action, the all-important action, as well as the simplest and most definite action, becomes the kind of action which all other kinds of action represent. And the sensation of resistance through which this fundamental action is known, becomes the mother-tongue of thought; in which all the first cognitions are registered, and into which all symbols afterwards learnt are interpretable.

§ 349. The matter will be further elucidated, and this last position especially confirmed, on observing that all the sensations through which the external world becomes known are explicable by us only as resulting from certain forms of force as thus conceived.

As already shown (§ 318), the so-called secondary attributes of body are dynamical. Science determines them to be the manifestations of certain energies possessed by matter; and even before scientific analysis they are seen to imply the actions of things upon us. But we cannot think

of the actions of things upon us, except by ascribing to them powers or forces. These powers or forces must be presented to our minds in terms of our experiences. And, as above shown, our only experience of force is the feeling of muscular tension which we have when overcoming force: this constitutes our consciousness of force, and our measure of force. Hence, besides the fact that our experiences of resistance form the original materials of thought; and besides the fact that our other experiences are employed by us as the representatives of these original experiences; there is the fact that we cannot understand these other experiences except by translating them into terms derived from our original experiences.

A concomitant truth of much significance is that resistance, as disclosed by opposition to our own energies, is the only species of external activity which we are obliged to think of as subjectively and objectively the same. *We are disabled from conceiving mechanical force in itself under a form different from mechanical force as ordinarily presented to consciousness.* The axiom—"Action and reaction are equal, and opposite," applied as it is not only to the actions of objects on one another, but to our actions on them and their actions on us, implies a conception of the two forces as equivalent, both in quantity and nature; seeing that we cannot conceive a relation of equality between magnitudes that are not connatural. How happens it that in this case alone we are compelled to think of the force outside of us as like the force we feel? Sound we can very well conceive as consisting in itself of vibrations, having no likeness whatever to the sensation they produce. The impressions we have of colour can, without much difficulty, be understood as purely subjective effects resulting from an objective activity to which they have not even a distant analogy. And similarly with heat, smell, and taste. Why, then, can we not represent to ourselves the force with which a body resists an effort to move it, as a something quite unlike the

feeling of muscular tension which constitutes the effort? There are all-sufficient reasons, of which we will first look at the accessory ones. Whether we strike or are struck, the sound, the indentation, the sensations of touch, pressure, and pain, are of the same kinds; and this furthers the conception of identity in their causes. We can make the force which is known to our consciousness as muscular tension, produce an effect like that produced by an external body—as when, taking one of the weights out of a pair of scales in equilibrium, we raise the antagonist weight by pressing down the empty scale with the hand: an experience which suggests equivalence between our effort and the pull of gravity. We can store up our own force in objects, and make them afterwards expend it in producing results such as it would have directly produced—as when we strain a bow and let its recoil propel the arrow: an experiment having a suggestiveness greater even than that of the last. These, however, as above implied, are but secondary causes. Let us pass to the primary cause. This is that *there exists no alternative mode of representing this force to consciousness*—no other experience, or combination of experiences, by which we can figure it to our minds. The liberty we have to think of light, heat, sound, &c., as in themselves different from our sensations of them, is due to our possession of other sensations by which to symbolize them—namely, those of mechanical force; and it needs but to glance at any theory of light, heat, sound, &c., to see that we *do* think of them in terms of mechanical force, that is, in terms of our muscular sensations. But if we attempt to think of mechanical force itself as different from our impression of it, there arises the insurmountable difficulty that there is no remaining species of impression to represent it. All other experiences having been expressed to the mind in terms of this experience, this experience cannot be expressed to the mind in any terms but its own. To be conceived, mechanical force must

be represented in some state of consciousness. This state of consciousness must be one directly or indirectly resulting from the actions of things on us or our actions on them. The states of consciousness produced by all other actions than mechanical action, we already represent to our minds in states such as those produced by mechanical action. There remains, therefore, no available state of consciousness save that produced by mechanical action. Hence it is impossible for us to represent mechanical action to ourselves in any other state of consciousness than that which it produces in us. Though the proposition that objective force differs in nature from force as we know it subjectively, is verbally intelligible; and though the supposition that the two are alike commits us to absurdities that cannot be entertained; yet to frame a conception of force in the *non-ego* different from the conception we have of force in the *ego* is utterly beyond our power.

§ 350. Having thus seen that the perception of resistance is fundamental, alike in respect of genesis, in respect of universality, and in respect of continuity; and that consequently it is also fundamental as being the perception into which all other perceptions are interpretable, while itself interpretable into none; we may proceed to consider it analytically.

As shown when treating of the statico-dynamical attributes of body, the sensations concerned in our various perceptions of resistance are those of touch proper, pressure, and muscular tension. The sensation of touch proper does not in itself give an immediate knowledge of resistance; but is simply the sign of something capable of resisting. When the contact is so gentle as to produce no feeling of pressure, it cannot be said whether the object is soft or hard, large or small. It is *inferred* that there is something: just as it would have been had a sensation of sound or colour been received. Hence the sensation of touch proper may be left out of the inquiry.

Knowledge of resistance, then, is gained through the sensations of pressure and muscular tension. These may occur separately. When I am wholly inactive, I have the sensation of pressure only—either from the reaction of the surface on which I rest, or from the action of a weight placed on some part of my body, or from both. When I bring my forces to bear on outward objects—when my body is active and objects are reactive—I have coexistent sensations of pressure and muscular tension. And when, as on raising my arm into a horizontal position, the bodily action is such as to call forth no direct reaction from objects, I experience the sensation of muscular tension alone. Here the fact to be more particularly noticed, is, that whenever the sensations of pressure and muscular tension coexist, they vary together. Now that I am holding my pen gently between the fore-finger and thumb, I have a slight sensation of pressure and a slight sensation of muscular tension. If I grasp the pen hard, both increase in intensity; and I find that I cannot change one without changing the other. The like relation is observable on raising light and heavy weights; or on thrusting against small and large objects. Hence these sensations become known as equivalents. A given feeling of pressure is thinkable as tantamount to a certain feeling of muscular tension; and *vice versâ*. And now there arises the inquiry—Which of these two is habitually used in thought as the sign and which as the thing signified?

In point of time the two are co-ordinate. From the very first, a developing creature experiences the reaction upon consciousness accompanying the action of its muscles. From the very first it has sensations of pressure from the surfaces on which it rests, and from the things laid hold of. But equally early though they are, it may be readily proved that in the order of constructive thought the sensation of muscular tension is primary and that of pressure secondary. This will be made tolerably manifest

by the simple consideration, that sensations of pressure caused by the weight of the body and by incident agencies, can at first give no notions of what we understand as resistance or force; seeing that before they can give such notions there must exist ideas of weight and of objective action. Originally the sensations of pressure which a developing creature passively receives, being unconnected in experience with definite antecedents and consequents, are as isolated and meaningless as sensations of sound or odour. Not to dwell upon this fact, however, further than to point out that the *involuntarily-produced* sensations of pressure may be left out of the question, let us, in the first place, observe that the *voluntarily-produced* sensations of pressure are second in order of time to the sensations of muscular tension. Before the creature can experience the feelings which neighbouring objects give to its moving limbs, it must experience the feelings which accompany motions of its limbs. In the second place we have to note that the muscular sensations are more general than the voluntarily-produced sensations of pressure; for the voluntarily-produced sensations of pressure occur only when the energies are employed upon external bodies, while the muscular sensations occur *both* when the energies are thus employed, and when they are employed in moving and holding up the limbs themselves. Further we have to remember that while only *some* of the sensations of pressure are voluntarily produced, *all* the sensations of muscular tension are voluntarily produced. And yet again there is the fact that when both are voluntarily produced—as when some object is grasped, or lifted, or thrust against—the muscular sensation is always present to consciousness as the antecedent while the sensation of pressure is the consequent; and that any variation in the last is known as following a variation in the first. Among the intelligible experiences of a developing creature, therefore, the sensation of muscular tension, being alike the earliest, the most general, and that

which immediately precedes the sensation of pressure whenever the origin of that sensation is known, becomes the sensation in which all experiences of resistance are registered. Hence the reason why, when anything pushes against us, we do not think of its force in terms of the pressure experienced, but in terms of the effort which that pressure signifies. Hence the fact that when calling to mind the weight of an object, we do not call to mind the intensity of the tactual impression which results on lifting it, but the intensity of the accompanying muscular strain.

That the consciousness of muscular tension forms the raw material of primitive thought, will be most clearly seen on considering that at first it is the only available measure of external phenomena. The acquisition of knowledge is from the beginning experimental. Were a creature to remain passive in the midst of surrounding objects, it could never arrive at a comprehension of them. It can arrive at a comprehension of them, only by active exploration. But what is the condition under which alone such an exploration will answer its end? How can the properties of things be compared, and estimated, and classified? By means of some *common measure* already possessed. The creature's only mode of determining the amounts of external activities, is by ascertaining how much of its own activity they are severally equivalent to. As inanimate objects cannot act on it in such way as to disclose their properties, it must call out their reactions by acting on them; and to become cognizant of their reactions implies some scale of action in itself. Thus, then, the sense of muscular tension, of which this scale is constituted, necessarily becomes the primitive element in our intelligence.

§ 351. Respecting the perception of resistance, that is of muscular tension, it has still to be pointed out that it consists in the establishment of a relation between the muscular sensation itself and that state of consciousness which we call

will—a relation such that the unbalanced surplus of feeling of whatever kind, which for the moment constitutes the will, is the antecedent of the muscular sensation, and coexists with it while it lasts. That the muscular sensation alone does not constitute a perception of resistance, will be seen on remembering that we receive from a tired muscle, a feeling nearly allied to, if not identical with, that which we receive from a muscle in action; and that yet this feeling, being unconnected with any act of volition, does not give any notion of resistance.

To which there is only to add that in the act of perception this relation is classed with the like before-known relations; and that in so classing it consists the knowledge of the special muscular combination, adjustment, and degree of force exercised.

CHAPTER XVIII.

PERCEPTION IN GENERAL.

§ 352. As foregoing chapters have made sufficiently manifest, the term Perception is applied to mental states infinitely varied, and even widely different in their natures. Between the consciousness of a vast landscape and the consciousness of a minute dot on the surface of this paper, there exist countless gradations which pass insensibly one into another; and which yet unite extremes almost too strongly contrasted to be classed together. A perception may vary indefinitely in complexity, in degree of directness, and in degree of continuity. We will glance at its variations under these heads.

In one of the primitive cognitions of resistance lately treated of, perception may rise but a step above simple sensation. Conversely, when watching the evolutions of a ballet, there is a consciousness not only of the multiplied relations of coexistent positions which constitute our notions of the distance, size, figure, and attitude of each dancer—not only of the various space-relations between the figure of each dancer and the several colours of her dress—not only of the relations of distribution among the dancers; but also of the many relations of sequence which the body and limbs of every dancer exhibit in their movements with respect to one another, and of those yet more involved relations of sequence exhibited in the movements of every dancer

with respect to the rest. In degree of directness, again, there is a similarly-marked contrast between the perception that some surface touched by the finger is hard, and the perception that a building at which we are looking is a particular cathedral. The one piece of knowledge is almost immediate. The other is mediate in a double, a triple, a quadruple, and even in a still higher degree. It is mediate inasmuch as the solidity of that which causes the visual impression is inferential; mediate inasmuch as its position, its size, its shape, are inferential; mediate inasmuch as its material, its hollowness, are inferential; mediate inasmuch as its ecclesiastical purpose is an inference from these inferences; and mediate inasmuch as the identification of it as a particular cathedral, is a still more remote inference resulting from the union of these inferences with those many others through which the locality is recognized. In like antithesis stand the degrees of continuity in our respective perceptions, now of an electric spark, now of a waterfall we are watching. And when we add the fact that our perceptions, or at any rate our visual perceptions, are continuous in Space as well as in Time—that when looking at a landscape and turning our eyes to different parts of it, we cannot say how many perceptions take in the panorama or where each perception ends; it will be abundantly-manifest that the state of consciousness which we call a perception is scarcely ever discontinuous with its like.

Thus a perception merges insensibly into others of its own kind, both synchronous and successive; and into others which we class as of different kinds, both superior and inferior. It passes at the one extreme into reasoning and at the other borders upon sensation. It may include innumerable relations simultaneously co-ordinated, or but a single relation. It cannot be demarcated from the nascent perceptions that coexist with it, nor (where the thing perceived is in motion) from the perceptions which follow it.

So that, however convenient a term Perception may be for common purposes, it must not be understood as signifying any truly scientific division.

§ 353. The only valid distinction to be drawn is that between Perception and Sensation. Though from time to time referred to with more or less distinctness by early philosophers, it is only in later times that this distinction has been currently acknowledged; and it is but recently that the relation between the two has been specifically formulated in the doctrine of Sir William Hamilton, "that, above a certain point, the stronger the Sensation, the weaker the Perception; and the distincter the perception the less obtrusive the sensation; in other words—though Perception proper and Sensation proper exist only as they coexist, in the degree or intensity of their existence they are always found in an inverse ratio to each other." Before criticizing this doctrine, which seems to me rather an adumbration of the truth than the truth itself, it will be needful to state the exact meanings of Sensation proper and Perception proper.

Manifestly every sensation, to be known as such, must be perceived; and hence, as thus considered, all sensations are perceptions. A mere physical affection of the organism does not constitute a sensation proper. While absorbed in thought I may be subject to undue heat from the fire, uncomfortable pressure from a hard seat, or a continual noise from the street; and though my sentient organs are very decidedly affected, I may yet remain unconscious of the affections—may become conscious of them only when they pass a certain degree of intensity; and only then can I be said to experience them as sensations. Nor is this all. In Sensation proper, at least if it is a sensation of touch or heat or pain, I not only contemplate the affection as an affection of myself—as a state through which my consciousness is passing or has passed; but I also contemplate it as existing in a certain part of my body—as stand-

ing in certain relations of position. I perceive *where* it is. But though under both these aspects Sensation must be regarded as one species of Perception, it will readily be seen to differ widely from Perception proper—from the cognition of an external object. In the one case, that which occupies consciousness is something contemplated as belonging to the *ego;* while in the other, it is something contemplated as belonging to the *non-ego*. And these it is which, as Sensation proper and Perception proper, are asserted to coexist in degrees of intensity that vary inversely.

That this is not altogether a correct assertion, will, I think, become apparent on carefully examining the facts as determined by experiment. Let the finger be brought against some hard rough body—say the jagged surface of a broken stone, the back of a ribbed sea-shell, or anything capable of giving a tactual impression of some complexity. Between the pressure used in ordinary touch and the pressure which is painful from its intensity, there are many gradations; and Sir William Hamilton's doctrine implies that, beginning with the pressure needful for distinct perception, and increasing it until the pain becomes unbearable, the perception gradually decreases in vividness while the sensation gradually increases in vividness; but that neither at the beginning nor the end does the one exclude the other. Do the facts correspond with this statement? We shall find that they do not. During the ordinary gentle pressure, consciousness is occupied entirely about the surface and its irregularities. No thought is taken of the sensations through which the surface and its irregularities are known. To attend to these sensations rather than to the objective phenomenon implied by them, requires a decided effort; and when they are thought of, it is in a state of consciousness quite distinct from the previous one. If the pressure be slowly increased, there is not a slow decrease in the vividness of the perception and a slow

increase in the vividness of the sensation; but the consciousness remains, as before, occupied about the surface: the hardness and roughness of which become the peculiarities most contemplated as the pressure becomes greater. Though the sensation may now be more easily thought of than before, and rises into greater distinctness when it is thought of, it can still be thought of only in a second state of consciousness not included in the original one. But observe what happens on pushing the experiment further. If the pressure be increased so far as to produce decided pain, there results quite a different state of consciousness, in which the thing contemplated is the subjective affection and not its objective cause. When the pain reaches any considerable intensity, it will be found that the perception has not only altogether ceased, but that it can be recalled into consciousness only by an effort. And it will also become manifest that were the nature of the object producing the painful pressure not already known, it would be unknowable. Generalizing the facts, then, it would seem, not that Sensation and Perception vary inversely, but that they exclude each other with degrees of stringency which vary inversely. When the sensations (considered simply as physical changes in the organism) are weak, the objective phenomenon signified by them is alone contemplated. The sensations, if not absolutely excluded from consciousness, pass through it so rapidly as not to form appreciable elements in it; and cannot be detained in it, or arrested for inspection, without a decided effort. When the sensations are rendered somewhat more intense, the perception continues equally-vivid—still remains the sole occupant of consciousness; but it requires less effort than before to make them the subjects of thought. If the intensity of the sensations is gradually increased, a point is presently reached at which consciousness is as likely to be occupied by them as by the external thing they imply—a point at which either can be thought of with equal facility, while

each tends in the greatest degree to draw attention from the other. When further intensified, the sensations begin to occupy consciousness to the exclusion of the perception; which, however, can still be brought into consciousness by a slight effort. But finally, if the sensations rise to extreme intensity, consciousness becomes so absorbed in them, that only by great effort, if at all, can the thing causing them be thought about.*

* Those who test this statement experimentally, should remember that the mere act of observing the *current* phenomena of consciousness, introduces a new element into consciousness, which tends to disturb the processes going on. The observations should be oblique rather than direct —should be made, not *during*, but *immediately after*, the appropriate experiences.

Since the foregoing passages were written in 1855, some interesting verifications have presented themselves — two of them quite recently. In *Nature* for August 18, 1870, Mr. R. B. Hayward, giving an account of a defective appreciation of colour under which he labours, remarks that his eyes differ in respect to their degrees of defectiveness, and that the eye which is the least appreciative of colours is the most appreciative of forms. In a subsequent number of the same periodical, (Sept. 1, 1870) Mr. L. Marshall gives like testimony. Until I met with these facts, I had supposed that the increased vividness of colouring which becomes apparent in a landscape when it is looked at with the eyes inverted, results from a change in the distribution of the colours falling upon the retina—a change such that each part receives a kind of light to which it is unaccustomed, and is therefore more sensitive. That this cannot be the chief cause, however, becomes manifest on observing that this brightening of the colours occurs in parts of the landscape which, casting their images upon the middle portion of the retina, affect the same elements of it in both positions of the eye, and also on observing that nearly if not quite as great an effect results when instead of inverting the eyes the head is so placed as to bring them into a vertical line. The true interpretation, to which the testimonies I have just cited point, lies in this antagonism between Sensation and Perception. When objects are looked at in the ordinary way, consciousness is chiefly occupied in interpreting the impressions made on the retina—is filled with the associated ideas which constitute knowledge of the objects seen as such or such; and so long as they are thus looked at it is impossible to prevent acts of recognition from taking place and absorbing a share of the attention. But when the eyes are inverted, or otherwise so placed as to throw out of gear all those relations of forms and distributions of parts through which the objects are identified, the associated ideas implied by

What now is the real nature of this mutual exclusion? Is it not an instance of the general fact that consciousness cannot be in two equally distinct states at the same time; and that in proportion as the predominance of one state becomes more marked the suppression of other states becomes more decided? I cannot know that I have a

the identifications do not readily arise, and consciousness remains so much the more occupied by the sensations of colour which compose the images received.

And here, indeed, we are naturally led to the physical interpretation of this antagonism. If from the subjective effects we pass to the objective counterparts of them, we see clearly the necessity of this inverse relation. For when from such an object as the ribbed sea-shell above instanced, there come to a nerve-centre moderate waves of molecular disturbance initiated by the pressures of its projections on the finger-end, there is an instant escape of these waves through plexuses of fibres to other centres; where there are awakened the correlative feelings which make up the consciousness of relative position, visible form of surface, degree of hardness, &c. These associated nervous actions are so nearly automatic that it is impossible to arrest them. Along the well-established channels there is so instantaneous an escape of the nerve-waves, which, if arrested, would be the equivalents of tactual feelings, that there are no consciously-recognized tactual feelings; but instead, consciousness becomes filled with all the associated ideas of form and appearance and inferred nature—there is perception. But now suppose that by a stronger pressure the amounts of the afferent nerve-waves are much increased. The various channels which draft off from the first nerve-centre reached, these larger waves of molecular motion, plus the molecular motion disengaged by them in this centre, becoming filled to the extent of their capacities, do not carry off the entire discharge so swiftly; and that disturbance in the tactual centre itself which answers to the feeling of touch, becomes a more considerable element —it becomes easier for the feeling of touch to be kept in consciousness. And then when the pressure has been made so hard as to cause pain, these plexuses through which ordinarily the escaping waves awaken the appropriate associated ideas, are no longer anything like adequate to draft off all the force brought to, and disengaged in, the tactual centre. The surplus that cannot be drafted off becomes so great, and the correlative feeling so intense, that the associated elements of consciousness become obscured —sensation now predominates and perception disappears. On referring to the "Special Synthesis," and more especially to § 211, the reader will find that this explanation harmonizes with the one there given of the relation between conscious and unconscious nervous action, and is verified by it.

sensation, without, for the moment, having my attention specially occupied with that sensation. I cannot know the external thing causing it, without, for the moment, having my attention specially occupied with that external thing. As either cognition rises, the other ceases. If, as Sir William Hamilton asserts, the two cognitions always coexist, though in inverse intensities, then if, beginning at either extreme, the conditions be slowly changed, so that while the cognition most distinctly present to the mind becomes gradually less distinct, the other becomes gradually more distinct; there must arrive a time when they will be equally distinct—when the subjective and objective phenomena will be thought of together with equal clearness; which is impossible. It is true that under such change of conditions there comes a time when the subjective and objective phenomena attract attention in equal degrees, and are thought of *alternately* with equal facility. And it may even be admitted that while either is being thought of, the other is nascent in thought. But saying this is not saying that they occupy consciousness together.

§ 354. Perception proper and Sensation proper, will however be best understood, and the purpose of the present chapter most furthered, by considering their antagonism under the light of preceding analyses.

In all cases we have found that Perception is an establishment of specific relations among states of consciousness; and is thus distinguished from the establishment of these states of consciousness themselves. When apprehending a sensation the mind is occupied with a single subjective affection, which it classes as such or such; but when apprehending the external something producing it, the mind is occupied with the relations between that affection and others, either past or present, which it classes with like relations. The sensation is known as an undecomposable state of consciousness.

The outward object is known through a decomposable state of consciousness; and is identified in virtue of the manner in which the component states are united. Now the contemplation of a special state of consciousness, and the contemplation of the special relations among states of consciousness, are quite different mental acts—acts which may be performed in immediate succession, but not together. To know a relation is not simply to know the terms between which it subsists. Though when the relation is perceived the terms are nascently perceived, and conversely, yet introspection will show that there is a distinct transition in thought from the terms to the relation, and from the relation to the terms. While my consciousness is occupied with either term of a relation, I am distinguishing it as such or such—assimilating it to its like in past experience; but while my consciousness is occupied with a relation, that which I discriminate and class is the effect produced in me by transition from the one term to the other. That the whole matter centres in the question—How do we think of a relation as distinguished from the terms between which it subsists? will be plain from the fact that Sir William Hamilton, while implying that it is something more, himself says that in one respect, "perception proper is an apprehension of the relations of sensations to each other." Joining which doctrine with the one here contended against, we see that, according to his hypothesis, the sensations and the relations between them can be simultaneously thought of with equal degrees of distinctness, or with any other relative degrees of distinctness—a manifestly-untenable proposition.

The only further remark called for is, that Perception cannot be correctly defined as "an apprehension of the relations of *sensations* to each other"; since in nearly all perceptions many of the elements are not presented but represented. When passing the finger over a rough surface, the

perception contains very much more than the co-ordinated sensations immediately experienced. Along with these there go the remembered visual impressions produced by such a surface, which cannot be kept out of the mind, and in the suggestion of which the perception largely consists; and there are automatic inferences respecting the texture and density of the substance. Again, when gazing at some one object, it will be found that objects on the outskirts of the field of view are recognized more by representation than by presentation. If, without moving his eyes, the observer will consider what is contained in his direct consciousness of these outlying objects, he will find that they impress him simply as ill-defined patches of colour; that were it not for his previous experiences he would not know the meanings of these patches; and that in perceiving what the objects are, he ekes out the vaguely-presented impressions with some comparatively-distinct represented ones. What thus manifestly happens with perceptions of this order, happens in one form or other with all perceptions. In fact, when analyzed to the bottom, all perceptions prove to be acquired perceptions. From its simplest to its most complex forms, Perception is essentially a diagnosis.

§ 355. To express most generally the truth that has been variously illustrated in detail—Perception is a discerning of the relation or relations between states of consciousness, partly presentative and partly representative; which states of consciousness must be themselves known to the extent involved in the knowledge of their relations.

Under its simplest form (a form, however, of which the adult mind has few, if any, examples) Perception is the consciousness of a single relation. More commonly, a number of relations are simultaneously presented and represented; and the relations among these relations are cognized. Most frequently, the relations of relations of relations are the objects of perception; as when any neighbouring solid body is

regarded. And very often—as when observing the motions of an animal, which are known to us as the relations between certain highly-complex relations of position now present and certain others just past—a still more involved relativity is contemplated.

Further, it is to be noticed that in the ascending grades of Perception there is an increase not only in the number and complexity of the relations grasped together, but also in the variety of their kinds. Numerous relations of position, of extension, of coexistence, of sequence, of degrees in all sensible qualities, are co-ordinated in one thought; or what appears to us such.

Add to which that, as heretofore pointed out in each special case, the act of perception is the establishment of a relation of likeness between the particular relation or group of relations contemplated, and some past relations or groups of relations—the assimilation of it to such past relations or groups of relations—the classing of it with them.

§ 356. It now remains only to apply the analysis thus far pursued to the relations themselves. By successive decompositions we have found that our intellectual operations are severally performed by establishing relations, and groups of relations, among those undecomposable states of consciousness directly produced in us by our own actions and the actions of surrounding things. But what are these relations? They can be nothing more than certain secondary states of consciousness, arising through connexions of the primary states. Unable as we are to transcend consciousness, we can know a relation only as some modification of consciousness. The original modifications of consciousness are the feelings aroused in us by subjective and objective activities; and any further modifications of consciousness must be such as result from combinations of these original ones. In all their various kinds and compounds, what we call relations can be to us nothing more

than the modes in which we are affected by bringing together sensations, or remembered sensations, or both. Hence what we have next to do is, first to resolve the special kinds of relations into more general kinds, ending with the primordial kinds; and then to ascertain what are the ultimate phenomena of consciousness which these primordial kinds express.

CHAPTER XIX.

THE RELATIONS OF SIMILARITY AND DISSIMILARITY.

§ 357. Of all relations the most complex is that of Similarity—that in virtue of which we range together objects of the same species, notwithstanding their differences of magnitude, and in virtue of which we group under the same head, phenomena of causation that are widely contrasted in degree. Already, in treating of Reasoning and of Classification, much has been said of this relation which forms their common basis. Here it needs only to state what it is when considered under its most general aspect.

The similarity which we predicate of natural objects belonging to the same species, is made up of many component similarities. Two horses unlike in size, are similar not only as wholes, but are also similar in their parts. The head of one is similar to the head of the other; the leg to the leg; the hoof to the hoof; the eye to the eye. Even the parts of the parts will be found more or less similar; as, on comparing two corresponding teeth, the crown to the crown, and the fangs to the fangs. Nay, such minute components as the hairs show in their structures this same parallelism. One of these ordinary similarities, therefore, consisting of an intricate plexus of similarities held together in similar ways, and resolvable as it consequently is into simple similarities, will, by implication, be analyzed in analyzing one of these simple similarities.

Though similarities of sequences do not admit of a complication parallel to that which similarities of coexistences admit of, yet they admit of another species of complication; namely, that arising from composition of causes and composition of effects. There are similarities of simple sequences and similarities of complex sequences. By the gravitation of a weight, the string to which the weight hangs may be elongated, and there may be no other appreciable results; while by the joint action of a certain temperature, a certain amount of moisture, and a certain miasm, upon an individual of a particular diathesis, who happens to be in a particular state, there may be produced the immense complication of effects constituting a disease. Each of these sequences is classed with others which we call similar; and in conjunction with them may form a premiss for future conclusions. And though, in the first case, we have a single antecedent and a single consequent, while, in the second case, we have a group of antecedents and a group of consequents—though in this second case the antecedent is not a force but a variety of forces united in a special plexus of relations, and the consequent is not an effect but a variety of effects united in a special plexus of relations; yet, we so obviously think of a composite cause and a composite effect, as related in the same way that a simple cause and a simple effect are related, that in treating of similar sequences we may confine our attention to the simple ones, as those out of which the others arise by complication of the terms.

Thus, then, choosing some primitive type of each, we have to consider what there is in common between similar coexistences and similar sequences.

§ 358. Of the one class, similar triangles furnish the most convenient example; and as an example of the other, we may take the uniform sequence of heat upon compression.

It is needless to do more than remind the reader, that in both of these cases the similarity resolves itself into

either equality of relations or likeness of relations—that triangles are similar when any two sides of the one bear to each other a relation equal to that which the homologous sides of the other bear to each other; and that when classing as similar the various cases in which compression produces heat, the likeness of the relations between compression and heat in those various cases, is the sole thing meant. Here it concerns us, not to dwell upon the fact that Similarity is likeness of relations, but to consider what this likeness of relations implies.

In the first place, we have to note that while it implies likeness in nature between the two antecedents and between the two consequents, it does not imply likeness in their amounts; but that, in nearly all cases, though not necessarily, the two antecedents are quantitatively unlike and the two consequents are quantitatively unlike. Two triangles may be similar, though any side of the one is a score times as great as the homologous side of the other; and though to-day a small disengagement of heat results from the pressure of a hundred pounds, while to-morrow a great disengagement results from the pressure of a hundred tons, the cases are classed as similar. So that thus regarded, similarity may be described as the likeness of relations whose antecedents are like in kind but mostly unlike in degree, and whose consequents are like in kind but mostly unlike in degree.

This likeness of relations has itself two phases. It may be both qualitative and quantitative; or it may be only qualitative. It may be a likeness of the relations both in kind and in degree; or it may be a likeness in kind only. Hence arise the two orders of Similarity—perfect and imperfect: the similarity on which mathematical reasoning proceeds and the similarity on which the reasoning of daily life proceeds. Thus, in the case of the triangles, the intuition of similarity implies, first, that the relations between extensions presented in the one, are com-

pared in thought with the like kinds of relations presented in the other. There can be no idea of similarity if a relation of coexistence between two sides of one triangle, is brought before consciousness along with some relation of extension between two sides of the other. Evidently, therefore, the primary element in the intuition of perfect similarity is—likeness of nature between relations. And then, joined to this, is the secondary element—likeness of degree between these connatural relations. The relations must be of the same order; and each antecedent must bear to its consequent a contrast of the same strength. In imperfect similarity, however, the only specific implication is—likeness of nature in the relations. When, in any new case, we think of heat as caused by compression, the implied similarity between such new case and previous cases, is simply a consciousness of connatural relations, of which the two antecedents are connatural and the two consequents are connatural. Nothing is said of degree. The new relation between compression and heat is simply thought of as a sequence like in kind to certain before-known sequences; and though there may be a vague idea of the quantity of heat as varying with the quantity of compression, this is not included in the predication.

Hence, while imperfect similarity involves the connature of relations whose antecedents are connatural and whose consequents are connatural; perfect similarity involves also the cointension of such connatural relations.

§ 359. Speaking most generally, then, the consciousness of Similarity arises when two successive states of consciousness are severally composed of like states of consciousness arranged in like ways. And when complete it is a consciousness of the cointension of two connatural relations between states of consciousness, which are respectively like in kind but commonly unlike in degree. This being the consciousness of a single similarity, it results that when, as

in ordinary cases, the similarity consists of many component similarities, each of the compared states of consciousness contains many relations which are severally connatural and cointense with the corresponding relations in the other.

Concerning Dissimilarity it needs only to be said that (neglecting all those ordinary misapplications of the word in which it is used to describe any kind of unlikeness, and confining our attention to dissimilarity proper) it is a consciousness of the non-cointension of two connatural relations between states of consciousness which are respectively like in kind, but commonly unlike in degree.

The relations of Similarity and Dissimilarity being thus proximately decomposed into certain more general relations, the further analysis of them is involved in the analysis of these more general relations; to which let us now proceed.

CHAPTER XX.

THE RELATIONS OF COINTENSION AND NON-COINTENSION.

§ 360. Keeping to the subjective point of view, and regarding every relation as some state of consciousness holding together other states of consciousness, it is first to be remarked that relations of cointension are of two kinds. The states of consciousness between which they subsist may be primary or secondary—may be simple states or the relations among simple states. Of these, the kind exemplified in the last chapter, and the kind we must here first deal with, is that subsisting between states of consciousness which are themselves relations.

§ 361. To know two states of consciousness as related implies a change in consciousness. That there may be a relation, there must be two states between which it subsists; and before there can be two states, definitely contemplated as such, there must be some change of state. On the one hand, no change in the state of consciousness can arise without involving two states standing in some relation; and on the other hand, no relation can arise until consciousness undergoes some change of state. These are two sides of the same necessary truth.

Now changes in consciousness differ widely in their kinds. The mental transition from a flash to an explosion is totally unlike that from a touch to a burn. Between an impression

produced by the colour of a rose and one produced by its odour, there is a contrast quite different from the contrast between the impressions of hardness and transparency which a crystal gives. Differences of kind among the changes in consciousness from one simple state to another, have, indeed, two orders: each of them extensive. There are the changes experienced when from a sensation of one class, we pass to a sensation of a wholly-unrelated class—changes that are of various kinds; and there are the changes experienced when from a sensation of one class, we pass to a sensation of the same class but of another species—changes that are also various in their kinds; though less widely unlike than the others. To speak more specifically:—We have, on the one hand, those most extreme changes which occur on passing from a colour to touch, from a taste to a sound, from a burn to a smell, from a sense of pressure to one of cold, from a feeling of roughness to one of dazzling, &c. On the other hand, we have the less extreme changes which occur on passing from one colour to another—as red to green, yellow to blue, pink to grey; or on passing from one taste to another—as bitter to sour, sour to sweet, sweet to bitter; or on passing from one sound to another, or from one smell to another. This is not all. When the transitions, instead of being from sensation to sensation are from percept to percept, or from concept to concept, there arise other orders of changes still more varied in their kinds.

Not only, however, do changes in consciousness differ widely in their *kinds* but they differ widely in their *degrees*. The differences in their degrees are divisible into two classes—those which arise when the successive states of consciousness are unlike in nature; and those which arise when the successive states of consciousness are like in nature. Observe first these differences of degree if the states are of unlike natures. If some loose gunpowder is exploded, the transition from the impression of light to that of a faint sound, is not the same as the transition from

the impression of light to that of a loud sound, which results if the powder is fired out of a pistol. Nor is the transition from the sensation of touch to that of temperature the same when grasping wood as when grasping iron. And evidently throughout all the various orders of changes above indicated, the like contrasts subsist. Equally multiplied and familiar are those other contrasts, subsisting between changes in consciousness that do not alter the nature of its state but only the intensity. Thus when, of two doors intervening between his ear and some continuous sound, one is suddenly opened, the change in a listener's consciousness is not so great as when both doors are suddenly opened. Nor, when contemplating in succession two allied shades of bright purple placed side by side, is the change in consciousness so great as on transferring the gaze from either of them to an adjacent shade of lilac. And here we have to note that those changes in consciousness which do not affect the nature of its state, are much more measurable than the others. Two alterations of intensity in the same kind of feeling, may be known as like or unlike in degree, far more completely than two transitions from one kind of feeling to another. And, indeed, it is doubtful whether these last can be considered measurable at all—whether the change from a light to a sound, being, as it were, total, must not be held as the same in degree with all other changes from light to sound: however much the relative amounts of light or sound may vary. But be this as it may, it is clear that in such cases all minor differences are dwarfed by the greatness of the contrast; and that, consequently, no accurate discriminations among the degrees of the changes can be made.

Now changes in consciousness, which we thus find to be various not only in kind but in degree, are themselves cognizable as states of consciousness: not, indeed, as simple states, but as states in which the transitions from state to state are the things contemplated. However it may seem that the change itself can be nothing additional to the

states themselves, it is unquestionable that we have the power of thinking of the change itself as something more than the two states individually considered. Possibly there is a physiological reason for this. Sundry facts point to the conclusion that the change itself constitutes a fleeting state of feeling, distinguishable from the less fleeting states which it links together. Every one knows that a violent change in the sensations is accompanied by a species of shock. Even though it be expected, a bright flash of light will cause the eyes to wink; and yet light of the same brilliancy, if continuous, can be steadily looked at without difficulty. The sudden application of cold water to the skin produces a start, notwithstanding a previous determination to bear it unmoved; and yet an equally intense sensation of cold, when once established, can be borne with equanimity. Nay, extremely marked transitions among the ideas will occasionally produce analogous effects. Many will readily call to mind cases in which the sudden remembrance of something important that had been forgotten, or the reception of unexpected news, produced a sensible shock. Whence it may be inferred that as the violence of changes in the state of consciousness is a thing of degree, all such changes are accompanied by some feeling however slight.*

But whether a change in consciousness be or be not knowable as something more than the juxtaposition of a preceding and a succeeding state, it is undeniable that we can so think of changes in consciousness as to distinguish their various kinds and degrees. In whatever way I cognize the transition from a sensation of touch to one of sound, it is beyond question that I can think of it as unlike in nature to the transition from a sensation of touch to one of cold. Whether in thinking of a change I think only of the two

* On referring to Part II., the reader will find, in § 65, a more satisfactory exposition of this doctrine. I have preferred to let the above paragraph stand as it did in the edition of 1855: making only some omissions and verbal amendments.

successive states, or whether I think of the effect wrought in me by the contrast between them, it remains alike true that in passing from an impression of the brightest green to one of bright green, and from one of bright green to one of pale green, I am conscious of two changes which are the same in kind but different in degree. And to say that I am conscious of these changes as such or such, *is to say that they are states of my consciousness.*

And now observe the implication. Being able to think of differences in kind and degree, not only between successive sensations but also between successive changes among sensations, it results that these changes are classifiable as the original sensations are. As two sensations can be known as like or unlike in kind; so can two changes among them be known as like or unlike in kind. And as two sensations that are like in kind can be known as like or unlike in intensity; so can two changes among them that are like in kind be known as like or unlike in intensity. We can recognize changes as connatural, or the reverse; and connatural changes we can recognize as cointense, or the reverse.

As above pointed out, however, changes in consciousness are nothing else than what we call relations. There can be no phenomena of consciousness beyond its successive states and the modes of succession of its states—the states themselves and the changes from one state to another. And since what we distinguish as relations are not the primitive states themselves, they can be nothing else than the changes from state to state. The two answer in all respects. We can think neither of a change nor of a relation without thinking of the two terms forming its antecedent and consequent. As we cannot think a relation without a change in consciousness from one of its terms to the other; so we cannot think a change without establishing a relation between a preceding phenomenon and a succeeding one.

The bearing of this conclusion on the inquiry before us is

this. Relations, subjectively considered, being nothing but changes in the state of consciousness, it follows that the cointension of relations is the cointension of such changes; or, in other words—likeness in degree between changes like in kind.

§ 362. Not much need be added respecting the simpler relation of cointension: that, namely, of which the terms are not relations among states of consciousness but the primary states of consciousness themselves. This is of course definable as—likeness in degree between feelings like in kind.

Nor, respecting the relation of non-cointension is it requisite to say more than that it is unlikeness in degree between either changes like in kind or feelings like in kind.

The only further remark to be made, is one concerning the use of the words cointension and non-cointension to denote these orders of relations. All our ideas of intensity, when traced to their origin, refer to the degrees of our feelings. We speak of intense heat and cold, intense pressure, intense pleasure and pain, intense passion, intense bitterness and sourness, intense irritation: in all of which cases we speak of feelings in respect to their degrees. Hence, in comparing simple states of consciousness that are alike in kind, we observe their relative intensities. If their intensities are equal, they must be called cointense; and the equality of their intensities is cointension. As the changes in consciousness are also different in respect of their violence, and are accompanied by some species of momentary feeling, they also are comparable in respect to their intensity; whence it follows that cointension is predicable of such changes, that is of relations, when they are alike in kind and degree.

CHAPTER XXI.

THE RELATIONS OF COEXTENSION AND NON-COEXTENSION.

§ 363. As was shown when treating of Space and of the statical attributes of Body, all modes of extension are resolvable into relations of coexistent positions. Space is known to us as an infinitude of coexistent positions that do not resist; Body as a congeries of coexistent positions that do resist. The simplest extension therefore, as that of a line, must be regarded as a series of coexistent positions; equal lines, as equal series of coexistent positions; and coextension, as the equality of separate series of coexistent positions.

It was explained at considerable length, that a series of coexistent positions is known to the developed mind through the simultaneous excitation of some series of independent sensitive agents distributed over the surface of the body; and that this simultaneous excitation being the equivalent and symbol of the successive excitations, the successive excitations are those in which all phenomena of extension, subjectively considered, must ultimately be expressed.

Hence, extension, as originally known, must be some succession of connatural states of consciousness of a special order; and as before shown, it must, in its primary form, be that order of states produced by the united sensations of motion and touch. Two equal extensions, then, are originally known to us as two equal series of united sensations of

motion and touch. And coextension, when reduced to its lowest terms, means—equality in the lengths of such series; that is—equality in the numbers of the states they severally include.

Two objections to this definition should be noticed. It may be considered a misuse of language to call that which we feel when drawing a finger over the skin, a *series* of states of consciousness; since the sensations of motion and touch are continuous. But saying nothing of the fact that the nerves which are one after another excited by the moving finger are independent, and must be supposed to convey separate impressions to the nervous centres, it will suffice to reply that though, in cases of this kind, the consciousness seems unbroken and homogeneous, it is in fact, *marked out* into many separate portions. A little introspection will show that during one of these seemingly-persistent feelings, the attention is transitorily occupied with various other things—with surrounding objects, with sounds, with the idea of self, &c. &c. What we are liable to take for a continuous state of consciousness, is really a state traversed by numerous incidental states which, by dividing it into portions, reduce it to a series of states. The second objection is that coextension, as ordinarily determined by the juxtaposition of the coextensive objects, involves no comparison between two series of states of consciousness, but merely an observation that the ends of the objects coincide. This mode of ascertaining coextension, however, is clearly an artifice, based on the experience that extensions separately known to us through the equal series of states they produce, always manifest this coincidence of their ends when placed side by side. As we are here dealing, not with the artificial test of coextension, but with the notion of coextension as it naturally arises, the objection is invalid: more especially as we have thus far considered, not the developed consciousness of coextension but that primary consciousness out of which it is developed.

§ 364. The nature of our developed consciousness of coextension will now readily be understood. The successive impressions through which extension is originally presented, having been transformed into synchronous impressions—the whole chain of connatural states, at first known in their serial positions, having become known in their coexistent positions; the consolidated states of consciousness resulting, become comparable, and their likeness or unlikeness recognizable, just as the chains of states to which they are equivalent. Each of these consolidated states is produced by the simultaneous stimulation of a certain number of independent nerves; and, physiologically considered, that likeness in the two states which constitutes the intuition in question, results from a likeness in the number and combination of the independent nerves simultaneously stimulated: supposing always that these nerves are distributed with like abundance on the two surfaces affected by the compared extensions.*

As implied by much that has gone before, it is this simultaneity in the excitation of independent nerves which gives the notion of coexistence, underlying that of extension, and therefore that of coextension. Only when coexistence has come to be thus disclosed, can extension and coextension, as we comprehend them, be conceived; seeing that extension implies coexistence in the parts of the thing extended.

* I add this qualifying clause for the purpose of recognizing the significant fact, that the estimation of a given extension is experimentally proved to vary according to the number of independent nerve-fibres supplied to the surface affected by this extension. One of the results established by Weber is that "two points, at a fixed distance apart, feel as if more widely separated when placed on a very sensitive part, than when touching a surface of blunter sensibility. This may be easily shown by drawing them over regions differently endowed; they will seem to open as they approach the parts acutely sensible, and *vice versâ*." (See Bain, *The Senses and the Intellect*, p. 173, Third Ed.) This result harmonizes very satisfactorily with all the conclusions reached in preceding chapters; and it is especially instructive as verifying, in an unexpected way, the explanation given in § 333 of the exaggerated estimates of space accompanying certain abnormal states.

Extension, therefore, as known by the developed mind, being made up of many elementary consciousnesses of co-existence; the relation of coextension cannot be exhaustively analyzed without analyzing the relation of coexistence. But in so far as the nature of our consciousness of coexistence has been incidentally explained, the relation of coextension, as subjectively considered, may be understood—may be defined as the likeness of two compound states of consciousness, visual or tactual, in respect of the number and order of the elementary relations of coexistence which they severally include: such compound states of consciousness being severally produced by the consolidation of what were originally known as serial states.

To which, for form's sake, it may be added that the relation of non-coextension is definable as the unlikeness of such two compound states of consciousness.

CHAPTER XXII.

THE RELATIONS OF COEXISTENCE AND NON-COEXISTENCE.

§ 365. Though to the developed mind apparently undecomposable, the relation of coexistence must be originally compound. Coexistence implies at least two things. These two things cannot occupy consciousness at the same instant in the same degree. And as they cannot pass through consciousness in simple succession, since they would then be known as sequent and not as coexistent, it follows that coexistence can be disclosed only by some duplex act of thought. True, the terms of a relation of coexistence of the simplest kind appear to be known, not in two states of consciousness but in one. The opposite ends of a short line looked at, or the opposite sides of a stick which is grasped, seem presented in a single intuition. But it needs only to recall the extremely complex process by which our perceptions of objects are built up, and to remember that what in the infant is an elaborate synthesis afterwards becomes an instantaneous cognition regarded as quite direct, to see that no apparent simultaneity in the consciousness of the two things between which there is a relation of coexistence, can be taken as disproving their original seriality. Leaving general considerations, however, let us look at the matter more nearly.

§ 366. If the eyes be directed to two small dots placed

close together on a sheet of paper, the facts that there are two, that they coexist, and that there is a certain space between them, certainly appear to be given in the same immediate intuition; and it seems a scarcely credible proposition that by a nascent intelligence they can neither be known as two, nor as coexistent, nor as having relative positions. But on reconsidering the conclusion reached in the chapters on Space, Time, and Motion, it will, I think, be manifest that at first, any two such dots can produce nothing but an indefinite visual sensation, as simple as one of sound or smell. For as was shown, the possibility of distinguishing the impression made on the retina as consisting not of one element but of two, implies, in the first place, that the retina has been so far developed that it consists of parts capable of being separately excited. It implies, in the second place, an accompanying development of the nervous centre such that the separate stimulations of these separate parts are distinguishable from one another in consciousness. But before these independent peripheral agents and independent central agents connected with them have been thus evolved, there must have been experiences accumulated and registered in these structures: the experiences by which the structures are produced, are themselves the experiences out of which grows a knowledge of the separateness. Or to state the case more conclusively:—Coexistence being unthinkable without a space in which the things may coexist, it follows that the two dots described cannot be known as coexistent without being also known as out of each other—as at some distance from each other. But, to suppose that when two sentient points on the surface of the organism are first simultaneously stimulated, some particular distance is thereby suggested, is to fall into the absurdity of supposing that an idea of some particular distance already exists in the mind. Evidently by a nascent intelligence the space between the two coexistent points is incognizable; and as their coexistence cannot

be otherwise conceived, it follows that at first they cannot be known as coexistent.

From all which it is an obvious corollary, that the relation of coexistence is disclosed by the same experiences which disclose extension. But now we have to observe an additional trait in these experiences. The repeatedly-described consolidation of serial states of consciousness into quasi-single states, is not the whole of the process by which the ideas of coexistence and extension are evolved. It is the peculiarity alike of every tactual and visual series which enters into the genesis of these ideas, that not only does it admit of being transformed into a composite state in which the successive positions become simultaneous positions, *but it admits of being reversed.* The chain of states of consciousness A to Z, produced by the motion of the hand over an object, or of the eye along one of its edges, may with equal facility be gone through from Z to A. Unlike those states of consciousness constituting our perceptions of environing sequences, which do not admit of unresisted changes in the order of their components, those which constitute our perceptions of coexistences may have the order of their components inverted without effort—occur as readily in one direction as the other. And this is the especial experience by which the relation of coexistence is disclosed. Let us glance at the chief phases of this experience.

Recurring to the adjacent dots, it will be observed that though very close and very small, they can never be both *perfectly* present to consciousness at the same time. The one on which the visual axes converge, is alone recognized with complete distinctness. The other, clearly before the mind as it seems, cannot be perceived with the highest degree of definiteness until the visual axes converge upon it; and when the gaze is thus transferred, the dot first contemplated ceases to be so definitely perceived. Moreover, if, while the eyes are fixed on one of the dots, the thoughts are directed to the other, it will be found that in

proportion as the other is distinctly thought of, the one to which the eyes are fixed tends to lapse out of consciousness. Either of which facts makes it clear, both that the serial experiences never wholly cease to be used, and that, even under the most favourable circumstances, the two terms of a relation of coexistence are not *absolutely* coexistent to the mind. Let us now observe what happens with dots further apart. If they are extremely minute, it will be found that even when there is only an inch between them, the one becomes invisible if the eyes are directed to the other, and cannot be known as coexistent with it except by a definite transfer of the attention. If they are dots of moderate sizes, the consciousness of one will be accompanied by some consciousness of the other until they are separated by a space of six or eight inches: beyond which, this nascent consciousness disappears. With larger objects there must be a larger interval—or, more strictly speaking, a greater subtended angle—to produce the same result. But however large the objects, there is a distance at which either ceases to be in any degree presented to the mind when the eyes are directed to the other. The unregarded object, when moved towards the outskirts of the field of view, does not disappear suddenly; but fades into nothingness gradually. And as, between those relative positions of two things in which their coexistence can be known only by a slight turn of the head, and those in which it can be known only by turning the head half round, there is also a series of imperceptible transitions; it follows that the coexistence of two dots lying close together, and that of two objects lying respectively behind and before the observer, are known in modes which are joined by insensible gradations, and must be primordially the same. In both cases, the terms of the relation of coexistence cannot be perfectly present to consciousness at the same moment. In both cases, motion is required to bring that term of the relation of which there is either no consciousness or but imperfect

consciousness, distinctly before the mind. And the differences are partly between the amounts of motion, and partly between the degrees of consciousness of this second term, which vary from no consciousness up to almost perfect consciousness.

This being understood, let us ask how the coexistence of two things not visible together is known. When a man, having just seen some object A, sees another object B, he usually asserts their coexistence on the strength of this single observation. He is enabled to do this by an accumulation of experiences which warrant the induction that certain groups of phenomena are persistent. But what does he mean by persistent? He means that the groups of phenomena are of a kind which he can again become conscious of with the same vividness as before. He means that on turning his head, the object A will impress him as it did at first. His assertion that A and B coexist means that the vivid states of consciousness which they severally produce in him, can be alternated as often as he pleases. Leaving, however, the coexistence that is known inferentially, we must here concern ourselves with those primordial experiences which yield the notion of coexistence. By an incipient intelligence, two things A and B, seen in succession, cannot be known to differ in their persistence from two sounds heard one after the other. In either case there is nothing but a sequence of impressions. How, then, do the two relations come to be distinguished? Simply by finding that whereas the terms of the first can be known in the reverse order with equal vividness, those of the second cannot. It is perpetually found that while certain states of consciousness follow each other with as much facility and clearness in one direction as in the opposite (A, B—B, A) others do not; and hence results a differentiation of the relation of coexistence from that of sequence.

More manifest still will this become, on remembering that

there are coexistences which even the adult never knows otherwise than through this test. While writing, I feel in my foot the warmth of the fire; I am aware of the pressure of my arm on the desk; I see the paper on which I write; and I hear a cart in the street. I find it impossible, however, to think of all these things at the same instant. I cannot join the heat, the sound, the pressure, and the whiteness, in the same state of consciousness; and still less can I be simultaneously conscious of their respective causes. How, then, do I know that I am receiving these various impressions at one time? How do I know that the external objects producing them are coexistent? I know it from the fact that I can be successively conscious of these various feelings in any order with equal facility.

§ 367. The equal facility with which the terms of a relation of coexistence can be thought of in either order, is knowable by us only through an internal feeling. That we habitually notice the feelings accompanying changes in consciousness, cannot be questioned, since we distinguish them by words. When we speak of a thing as *hard* to think, or *easy* to believe, we express by these adverbs the presence or absence of mental tension. In the one case, the consequent can be made to follow the antecedent only by a great effort; in the other, by little or no effort. When attempting to remember a forgotten name, or when continuing to puzzle over some calculation, or when trying to form an unusually-complex conception, there is a distinct consciousness of inward strain. Whence it is clear that the states of consciousness constituting a thought, may follow one another without difficulty or with any degree of difficulty; and that the difficulty is known to us by the feeling accompanying the transition.

Consequently, to distinguish the relation of coexistence as one of which the terms will follow one another through consciousness in either order with equal facility, is to say

that there is a likeness or equality of the two feelings of facility which accompany respectively, the change from antecedent to consequent, and the change from consequent to antecedent. There may not be a likeness or equality of the two feelings produced by the contrasts of the terms, for these nearly always differ according to the order in which the terms are contemplated; but there is a likeness or equality of the two feelings of resistance—or rather in this case, non-resistance—which occur at the moments of transition.

So that the relation of coexistence under its primary simple form, is to be defined as a union of two relations of sequence, which are such that while the terms of the one are exactly like those of the other in kind and degree, and exactly contrary to them in their order of succession, the two relations are exactly like each other in the feeling which accompanies the succession. Or otherwise, it may be defined as consisting of two changes in consciousness, which, though absolutely opposite in other respects, are perfectly alike in the absence of strain. And of course the relation of non-coexistence differs in this, that though one of the two changes occurs without any feeling of tension, the other does not.

§ 368. It may be worth while to point out, that these conclusions are indicated even by *à priori* considerations. For if, on the one hand, the great mass of external phenomena are statical, or not actively changing; and if, on the other hand, perpetual change is the law of internal phenomena—the condition under which only consciousness can continue; there arises the question—How can outer statical phenomena be represented by inner dynamical phenomena? How can the no-changes outside be symbolized by the changes inside? That changes in the *non-ego* may be expressed by changes in the *ego*, is comprehensible enough; but how is it possible for objective rest to be signified by

subjective motion? Evidently there is only one possibility. A consciousness ever in a state of change, can represent to itself a no-change, only by an inversion of one of its changes—by a duplication of consciousness equivalent to an arrest—by a regress which undergoes a previous progress—by two changes which exactly neutralize each other.

Finally, the reader should be reminded that this analysis of the relation of coexistence, showing that it is a relation disclosed by experience, supplies an ultimate disproof of the hypothesis that Space is a form of intuition; since the consciousness of coexistence is the primitive element out of which the consciousness of space is built—is the element without which even the germ of that consciousness is impossible.

CHAPTER XXIII.

THE RELATIONS OF CONNATURE AND NON-CONNATURE.

§ 369. After what has been said concerning it in § 360, but little need here be added respecting the relation of connature. It is of two kinds. In the one, the terms between which it subsists are themselves relations, or changes in consciousness. In the other, they are the primitive states of consciousness between which such changes occur. Let us first glance at the more complex of these.

When treating of the relation of cointension, it was pointed out that simple changes from one primitive state of consciousness to another are of several classes. There are those in which the antecedent and consequent states are of different orders—as when the transition is from a tone to emotion; those in which they are of different genera—as when the transition is from a flash of light to a bang; those in which they are of the same genera but of different species—as when the transition is from the colour green to the colour red; and those in which they are of the same species, but of different degrees—as when the transition is from a faint sound to a loud one. And these being the different kinds of change between states of consciousness distinguished as simple feelings, it is manifest that when the states of consciousness become composite, a great multiplicity of kinds of changes arise—changes from greater to less in magnitude, from slow to quick in velocity, from ascent to descent, &c. Hence those various orders of changes implied by the negations of the relations already treated of—the changes indicated by the terms dissimilarity,

non-cointension, non-coextension, non-coexistence. And hence also those processes of consciousness through which we class lines with lines, areas with areas, bulks with bulks —all of them distinguished by us as different orders of relations; that is, different orders of changes among the states of consciousness.

Nothing is to be said respecting the connature of relations in its various modes, beyond describing it; for the relation of connature is not decomposable into other relations. That two changes in consciousness are of like kind, is a fact of which we can give no account further than that we perceive it to be so. When two transitions in consciousness produce in us two like feelings, we know nothing more than that we have the like feelings. It is true, as will be shown in a subsequent chapter, that it is possible to say specifically what we mean by asserting the likeness of these feelings. But beyond this it is impossible to go.

As subsisting between relations, therefore, the relation of connature must be defined as—likeness of kind between two changes in consciousness.

§ 370. Respecting the relation of connature as subsisting, not between relations, but between primary states of consciousness—feelings or the representations of them—still less is to be said. What is the nature of the feelings which we have of warmth, of blueness, of pressure, of sweetness, no one can say. They are undecomposable elements of thought with which analysis can do nothing. And when we assert the connature of any two such feelings—their likeness in kind—we express an intuition of which we can say nothing further than that we have it. Though, as will by and by be seen, the intuition may be otherwise expressed, it cannot be decomposed.

To justify the title of the chapter, it must be added that the relation of non-connature is—unlikeness in kind between either changes in consciousness or the states which they connect.

CHAPTER XXIV.

THE RELATIONS OF LIKENESS AND UNLIKENESS.

§ 371. At length continued analysis has brought us down to the relations underlying not only all preceding relations, but all processes of thought whatever. From the most complex and most abstract inferences down to the most rudimentary intuitions, all intelligence proceeds by the establishment of relations of *likeness* and *unlikeness*. Duly to appreciate this truth, we must glance at the successive conclusions arrived at in preceding chapters.

In the highest kinds of compound quantitative reasoning, we found that each of the several intuitions which make up a demonstration, not only involves the relation of *likeness* under its highest form—that of *equality*—but involves it in the most various ways. We found that in descending step by step to the lower kinds of reasoning, the intuitions of *likeness* included in each ratiocinative act become less numerous and less perfect; but that to the last, *likeness* of relations is necessarily involved. The classification of objects, we found to imply a perception of the *likeness* of a new group of relations to a before-known group, joined with more or less *unlikeness* of the individual attributes; while recognition implies *exact likeness*, both of the individual attributes and their relations, to those of groups before known. And we further saw that the perception of a special object is impossible save by thinking of it as *like* some

before-known class or individual. The perception of Body, as presenting its three orders of attributes, we found to imply a classing of the several attributes, their relations to each other, and the conditions under which they are disclosed, with *like* attributes, relations, and conditions. It was shown that our perceptions of Space, Time, and Motion, arise by a discovery of the *equivalence* of certain states of consciousness, serial and simultaneous; and further, that no particular space, time, or motion, can be thought of without the relation of *likeness* being involved. More recently we have seen that the higher orders of relations are severally resolvable into relations of *likeness* and *unlikeness* whose terms have certain specialities and complexities. Similarity, was defined as the cointension of two connatural relations between states of consciousness which are themselves *like* in kind but commonly *unlike* in degree. Cointension, we found to be, *likeness* in degree either between changes in consciousness that are like in kind, or between states of consciousness that are *like* in kind. It was shown that coextension is the *likeness* of two composite states of consciousness, in respect of the number and order of the elementary relations of coexistence which they severally include. Coexistence, was resolved into two sequences whose terms are exactly *alike* in kind and degree, exactly *unlike*, or opposite, in their order of succession, and exactly *alike* in the feeling which accompanies that succession. Connature was defined as *likeness* in kind either between two changes in consciousness or between two states of consciousness. And each of these relations we found to have its negative, in which *unlikeness* is the thing predicated.

Seeing, thus, that the knowing of successive states and changes of consciousness as like or unlike, is that in which thinking consists, we have next to inquire what is the essential nature of those phenomena in consciousness which we signify by the words likeness and unlikeness.

§ 372. Things can be truly defined only in terms more general than themselves; and hence unless there is some relation underlying the relations of likeness and unlikeness, they must be indefinable. Strictly speaking, no such more general relation exists. The only relation remaining to be dealt with is one that is co-ordinate with them—one that is in fact another side of the same mental phenomena. All we can do is to describe likeness and unlikeness in terms of this remaining relation, and to describe this remaining relation, when we come to it, in terms of likeness and unlikeness —to exhibit them as the necessary complements of each other.

This premised, the question above asked will be most readily answered by comparing the relations of likeness and unlikeness together. The essential nature of each will best be shown by contrasting it with the other. In what, then, consists the difference between the two mental processes by which these relations are disclosed?

If I cut in two a sheet of blue paper, and place the pieces at some distance apart; and if I also place at some distance apart, two pieces of paper of different colours—say red and green; I have in the first pair a relation of likeness and in the second pair a relation of unlikeness. What constitutes my knowledge of each of these relations? On glancing from one of the blue pieces to the other, I am conscious of passing from one state to another state, which is new in so far as it is separate from, and subsequent to, the first, but which is not otherwise new. On glancing from the red to the green, I am conscious of passing from one state to another state, which is new not only as being subsequent, but which is otherwise new. Suppose now that I place the blue pieces close together, joining the edges which were made by the cut; and that I also place the red and green pieces close together. What happens? The two blue pieces are not now known in two distinct states of consciousness: the two states of consciousness practically merge into one. The red

and green pieces, however, placed no matter how close, still produce two states when contemplated. Similarly with sounds. A sustained note made by the voice or by an instrument, may be unbroken and homogeneous, or it may be interrupted by some slight flaw, serving nominally to divide it into two notes that are exactly alike. But while, when we listen to such a note, consciousness may with almost-equal propriety be considered in one state or two states, when we listen to any musical interval we very decidedly experience two states.

It is sufficiently manifest, then, that by the words unlike and like, we signify the occurrence or non-occurrence of *change* in consciousness. Leaving out of sight for a moment that fleeting consciousness which marks a transfer of the attention, and which strictly considered is a change, we may say that by unlikeness and likeness we mean respectively, *change* and *no change* in consciousness. The two terms of a relation of unlikeness are two states of consciousness forming the antecedent and consequent of a *change* in consciousness. The two terms of a relation of likeness are the antecedent and consequent of what, in one sense, is *no change;* seeing that it leaves consciousness in the same condition as before.

§ 373. As implied, however, this is but an approximate statement which, if interpreted literally, describes an impossibility. For as the relation of likeness implies two states of consciousness; and as two states of consciousness, if not themselves different, cannot exist as separate states unless they are divided from each other by some state that is different; it follows that a relation of likeness implies a change, or rather changes, in consciousness. Accurately speaking, therefore, a relation of likeness consists of two relations of unlikeness which neutralize each other. It is a change from some relatively-enduring state A to another state x (which represents the feeling we have while

passing from one of the like things to the other), and a change from this transitory state x to a second relatively-enduring state A: which second state A would be indistinguishable from the first state were it not divided from it by the state x, and which merges into such first state when the state x disappears from the approximation of the two like stimuli in space or time.

Very many relations of unlikeness similarly consist of two relations of unlikeness, which, however, fail to neutralize each other. In all cases where the two terms of the relation do not follow through consciousness in juxtaposition—as when the unlike things looked at are some distance apart, or when between unlike sounds a brief interval of time elapses—there are three states of consciousness involved; the original state A, the transition state x, and that state of which we predicate unlikeness, B. But the primordial relation of unlikeness consists of two states only. When two notes differing in pitch strike the ear in quick succession, so as to leave no time for any intervening thought or sensation—when a flash of lightning for a moment dispels the darkness—when any one state of consciousness is directly supplanted by another state, there is established a relation of unlikeness.

Thus, then, the relation of unlikeness is the primordial one—is the relation involved in every other relation; and can itself be described in no other way than as a *change* in consciousness.

CHAPTER XXV.

THE RELATION OF SEQUENCE.

§ 374 As was said in the last chapter, this remaining relation is but another side of the one there treated of. Sequence is change; and change, as known by us, is the unlikeness of a present state of consciousness to a past state. While on the one hand, the two terms of the relation of unlikeness cannot be known without a change in consciousness, on the other hand, there cannot be a change in consciousness without there being two states standing in a relation of unlikeness. The fundamental or undecomposable relation must have two terms—two juxtaposed states of consciousness. These must be unlike, otherwise they will constitute not two states but one. To be known as unlike they must be known in succession, since consciousness cannot be in two states at the same time. The ultimate relation, therefore, is nothing more than a *change* in the state of consciousness; and we call it either a relation of unlikeness or a relation of sequence, according as we think of the *contrast* between the antecedent and consequent states, or of their *order*.

Beyond thus describing each aspect of this relation in terms of the other aspect, no account can be given of it. Like every primordial experience—like the sensation of redness or that of warmth, it transcends analysis. All that is left to be done is to classify the relations of sequence, and

to inquire how the classes are distinguished from one another. To do this completely is by no means easy, and would occupy more space than can here be afforded. It must suffice to describe the leading distinctions.

§ 375. It is tolerably manifest that these distinctions cannot be originally given in the consciousness of the sequences themselves. By a nascent intelligence, the relation between two sensations that severally answer to some external cause and effect, cannot be known as essentially unlike that between two sensations that follow one another fortuitously. The two relations are two changes in consciousness, and nothing more. If, then, some changes, some sequences, are afterwards found to differ in nature from others, the difference must be in some collateral property disclosed by further experience. What is that property?

Comparison of a few cases will show us the answer to this question. After hearing in immediate succession two notes of different pitch, no difficulty is found in making those notes—or rather, the ideas of them—pass through consciousness in the reverse order. After an ascending fifth has been struck on the piano, it is easy to represent the sounds so as to make a descending fifth: the two states of consciousness produced may readily be re-thought in inverted sequence. Not that the two states thus voluntarily changed in their order, are entirely like the original states. Though they are like in their natures they are widely unlike in their intensities. While the original states, which we know as two sensations of sound, are vivid, the two ideas which we find may be transposed are faint repetitions of them. And this it is which distinguishes one of these reversible sequences from a coexistence. If the successive states of consciousness A, B, can be made to occur in the opposite order B, A, without any diminution of vividness, the relation between them is what we know as coexistence. But if the states A, B, when they occur in opposite order,

can be made to do so only as the weak states B, A, the relation between them is that of reversible sequence. Thus much to prevent misapprehension. What it now concerns us to observe is, that there are sequences whose terms having been presented in one order, admit of being represented in the opposite order with great facility. Not that they occur in this opposite order with as much facility as in the original order. Two feelings that were experienced in a certain succession, tend, when recalled, to pass through consciousness in a like succession; and it is in virtue of their tendency to do this that we know them to have occurred in that succession; or rather, it is their recurrence in this succession which *constitutes* our knowledge of their original succession. But though, when uninterfered with, the represented feelings follow one another in an order like that in which the presented ones followed; yet, in cases such as the one instanced, the slightest effort of volition reverses the order—an effort so slight as to be unaccompanied by any sense of tension. That *some* effort is required, may be inferred; since, while the represented impressions *involuntarily* follow one another in the original order, they do not follow in the opposite one, unless *voluntarily*. This, however, is the sole appreciable distinction. And these are the sequences which, objectively considered, we class as *accidental*.

If now, instead of two phenomena that have occurred in a fortuitous succession, or in a succession which to our ignorance seems fortuitous, we take two phenomena that have occurred in a certain order with considerable regularity, we shall find that the relation subsisting between the states of consciousness answering to them has a somewhat different quality. Instance the shouting to any one and the turning of his head. These two phenomena, frequently experienced in this order, have produced a mental connexion such that the occurrence of the one almost inevitably suggests an idea of the other. Moreover, the states of con-

sciousness thus associated in experience have no tendency to occur in the opposite order. The turning of another person's head does not make us think of a shout. Nevertheless, there is little or no difficulty in reversing the order of these states. The thought of a person turning his head may be instantly followed by the thought of a shout, if we so will it. Sequences of this kind then, are distinguished by the peculiarity that though, when the antecedent is presented or represented, a representation of the consequent cannot without difficulty be prevented from rising in consciousness, yet these two states can readily have their order of succession changed. And this is the character of the sequences which, objectively considered, we class as *probable*.

When, however, we pass from *non-necessary* sequences to *necessary* sequences, we find not only that the states of consciousness are so connected that when the antecedent is presented it is impossible to prevent the consequent from following it, but also that the antecedent and consequent do not admit of transposition. As an illustration of the first peculiarity, may be taken our inability to think of a heavy weight as breaking the string by which it is suspended, without thinking of the weight as falling. And the last peculiarity is illustrated in the fact that the relation between a blow and an antecedent motion, cannot be represented to the mind in the reverse order.

§ 376. Thus the relation of sequence, considered subjectively as a change in consciousness, is of three general kinds. The fortuitous, in which the two terms are as nearly as may be *alike* in their tendency, or want of tendency, subsequently to suggest each other; and in which the change may be reversed in thought with a feeling of non-resistance *like* that with which it originally occurred. The probable, in which the terms are *unlike* in their tendency to suggest each other; but in which the usual

order of the terms may be inverted with but little effort. And the necessary, in which the antecedent being presented or represented to consciousness, the consequent cannot be prevented from following; and in which the direction of the change cannot be changed.

Leaving though it does much to be explained, this statement will serve to show that the classification of sequences is itself effected through other sequences. This classification, depending on the different modes in which the sequences comport themselves when tested, involves, at the outset, the ideas of *like* and *unlike;* while the process of testing them is itself an observing of the degrees of *likeness* or *unlikeness* between certain feelings they severally yield under experiment. And since the relations of likeness and unlikeness are the one a double sequence and the other a single sequence, it results that the classing of sequences implies the making them the terms of secondary sequences. As all relations are finally reducible to one, which is nothing else than a *change* in consciousness, it follows, even *à priori*, that all relations among the changes in consciousness must themselves be other changes.

CHAPTER XXVI.

CONSCIOUSNESS IN GENERAL.

§ 377. Successive decompositions of the more complex phenomena of intelligence into simpler ones, and of these into still simpler ones, have at length brought us down to the simplest; which we find to be nothing else than a change in the state of consciousness. This is the element out of which are composed the most involved cognitions. Analysis leaves us no alternative but to hold that the perception of a vast landscape consists in a multitude of co-ordinated changes; and that of co-ordinated changes also, consists the most abstract conception of the philosopher.

This result, reached by taking to pieces our cognitions, is, indeed, the one indicated by *à priori* considerations. To be conscious is to think; to think is to put together impressions and ideas; and to do this, is to be the subject of internal changes. It is admitted on all hands that without change, consciousness is impossible: consciousness ceases when the changes in consciousness cease. If, then, incessant change is the condition on which only consciousness can continue, it would seem to follow that all the various phenomena of consciousness are resolvable into changes. Even from a general view of the facts, therefore, may be prophesied the issue to which a detailed analysis has led us.

Still more clearly may this same issue be foreseen, when it is remembered that we can become conscious only

through the changes caused in us by surrounding things. Here is an organism placed in the midst of objects. If it is uninfluenced by them, it can know nothing of them—think nothing of them. Their existence cannot be revealed to it unless by the effects they produce on it—the changes they work in it. Only through changes can it be made conscious of an external world; and only out of changes can be constructed that knowledge of an external world which is possible to it.

But a full comprehension of this truth that the primordial element of all intelligence is simply a change, and that every complex mental phenomenon is a co-ordinated group of changes, will best be gained by arranging synthetically the results lately reached by analysis. After contemplating in their order of genesis, a few of the primitive cognitions treated of in recent chapters, both the particular conclusions there reached, and the general conclusion based upon them, will be clearly understood.

§ 378. As already sufficiently explained, absolute quiescence in consciousness is cessation of consciousness. To constitute a consciousness, however, incessant change is not the sole thing needed. If the changes are altogether at random, no consciousness, properly so called, exists. Consciousness is not simply a succession of changes, but an *orderly* succession of changes—a succession of changes *combined and arranged* in special ways. The changes form the raw material of consciousness; and the development of consciousness is the *organization* of them. This premised, let us consider under what conditions consciousness becomes nascent.

The lowest form of consciousness that can be conceived, is that resulting from the alternation of two states. When there is a change from state A to state B, and from state B to state A—that is when states A and B come into existence as the antecedents and consequents of changes, each

change constitutes a phenomenon in consciousness; and the recurrence of such changes becomes a consciousness. Not that such a consciousness is one which we can realize to ourselves, or one which would ordinarily be termed consciousness. We must regard it as the first step towards the evolution of consciousness proper—a step such as we may imagine to have been taken in the lowest animals that manifest sensibility. But now let us inquire what is given in this first step. By the hypothesis, the second state B differs from the first state A—constitutes a second state only in virtue of being different; that is to say, A and B are *unlike*. That there can exist any cognition of them as unlike is not to be supposed. Such a cognition implies a complicated mental act that becomes possible only after considerable development. All we have now to note is, that this first phenomenon is one of the experiences out of which are ultimately elaborated the ideas of *change*, of *sequence*, of *unlikeness*. Suppose that there occurs the change B to A. Here are the materials for a second relation of sequence—a second relation of unlikeness. But this is not all. There has now arisen a second state A, *like* the first state A. Data have been presented which, in an advanced consciousness, would constitute a relation of *likeness*. At present, however, even supposing a latent capacity for thinking such a relation, it cannot be thought from lack of experiences to class it with. Let there occur another change, A to B. This constitutes a second relation of unlikeness, of the same nature as the one first established—a change or relation *like* the before-experienced relation. There are now given the materials which, did there exist a power of co-ordinating them, might compose a thought. There have arisen two relations of likeness between primitive states of consciousness—between A and A, and B and B; and also a relation of likeness between two changes—between two relations of unlikeness. By a practised consciousness.

this second change or relation would be thinkable as like the first—might be classed with it, or assimilated to it. Let another change B to A arise. A further relation of unlikeness is presented, like a foregoing one. And by a perpetual repetition of these changes A—B, B—A, the two states and their two relations tend to become more and more cognizable. Thus, even in a consciousness of the lowest imaginable type, there are foreshadowed the relation of sequence, the relation of unlikeness among the sensations, the relation of likeness among the sensations, the relation of unlikeness among the changes, and the relation of likeness among the changes. The earliest possible experiences are those supplying the raw material from which these cognitions are developed.

Suppose that a third state, C—a third kind of sensation, is now joined to the others. Further relations of likeness and unlikeness between states and between changes result. But not simply can there occur a greater variety of phenomena of the same kind: new kinds of phenomena become possible. The two states A, B, we have assumed to alternate with equal facility in each direction A—B, B—A. If, however, the new state C frequently follows B but never precedes it, there results an experience of two orders of change which become known by contrast: the duplex change A—B, B—A, answering to the relation of co-existence, and the single change B—C, answering to the relation of sequence proper. Moreover, after this introduction of a third state, it becomes possible for some particular combination to be established as one of more frequent recurrence than the others; and the recurrence of such particular combination, B—A—C for example, supplies the material for a relation of likeness, not between one single change in consciousness and previous changes, but between a group of changes and previous groups. Nor is this all. The more varied experiences that now arise of the relations of likeness and unlikeness, which subsist between several

kinds of primitive states, several kinds of single changes, and several kinds of compound changes, afford data for the consciousness of likeness and unlikeness in general, apart from the particular terms between which they were first established.

Supposing this introduction of new sensations, new changes, and new combinations among them, to be carried on step by step, let us mark what must result from that universal law, that the more frequently mental states have occurred in a certain order the more easily and rapidly do they follow one another in that order. In proportion as the specially-combined states D—B—A—C, have been repeated, the time occupied in the transition from the first to the last becomes abbreviated; and ultimately this series of states and changes takes no more time than one of its constituents originally did. The consequence is, that these compound changes tend to become more and more clearly thinkable as single phenomena in consciousness—more and more readily classable with the like previous phenomena and distinguishable from others. But now observe the important fact that in proportion as a chain of such changes is consolidated into a single change, *in the same proportion do the several sensations which form the antecedents and consequents of the changes, become present together.* When the compound change D—B—A—C, takes place, as it ultimately does, almost instantaneously, it results that before the first sensation or idea D, has ceased, the others B, A, C, have severally arisen. Hence there is produced a consolidated consciousness in which many sensations appear to be simultaneously presented—a consolidated consciousness answering to some outward object that habitually gives this group of sensations. And we have but to conceive an endless progress in this consolidation of changes, to comprehend how there can arise the consciousness of complex things—how the objects with which human intelligence deals become thinkable as like and unlike—how the highest acts of perception and reason become possible.

§ 379. Of course the actual genesis of intelligence is incomparably more complex than it is here represented to be. This description simply shadows forth the nature of the process—exhibits the fundamental principles of it. The successive complications above suggested in rapid succession, can in reality arise only by insensible degrees. Each order of experiences must be registered in the nervous structures by long-continued habit, before any higher order can be dealt with. Each constantly-united group of states of consciousness must be more or less completely fused into one state, before any further complexity can be reached by the combination of such groups. In respect of its progress, this organization of experiences must conform to the laws of organization in general; and must therefore be extremely slow.

Taking the above description, however, as exhibiting the *method* of the process in its most general outlines, it will serve to show that at the very outset there are involved the materials of those fundamental relations to which analysis has, from the very beginning, pointed. It will serve to make more comprehensible how, out of change, kind of change, degree of change, facility of change, arrangement of change, &c., the infinitely-varied states of consciousness may be elaborated. And it will serve to suggest how, by the ever-progressing consolidation of changes—the running together of larger and larger groups and series of them—there can arise, out of internal phenomena originally successive, the means of representing those extremely-complicated phenomena of coexistence which constitute the external world.

CHAPTER XXVII.

RESULTS.

§ 380. Among the truths to be gathered from the foregoing chapters, one of the most significant is that there exists a *unity of composition* throughout all the phenomena of intelligence. At the outset we saw that the most complex processes of reasoning are resolvable into intuitions of likeness and unlikeness between terms more or less involved. Under various modes, complications, and degrees of perfection, these intuitions were found to be traceable not only throughout all kinds of reasoning, but throughout all kinds of perception: constituting in every case the general structure of the cognition, whatever its particular substance. And we have recently seen, both analytically and synthetically, that these intuitions are foreshadowed in the very first stages of an incipient consciousness.

Standing together, this consistency in its particular results and their subordination to one general result, supply strong confirmation of the analysis; both as a whole and in its several parts. But they will be seen to supply yet stronger confirmation if we reflect that it is inferable, even *à priori*, that analysis must disclose some such universal law. For whatever may be the conditions under which alone consciousness can exist, they must be common to all kinds and degrees of consciousness. They must be disclosed along with the initial phenomena of consciousness; and must

underlie each of the more complex phenomena built out of these initial phenomena. In other words—there must be some *form of thought,* exhibited alike in the very lowest and the very highest manifestations of intelligence. Hence, when we find that in the first changes of the simplest conceivable consciousness, data for the relations of likeness and unlikeness are given—that these relations form but another side of the very changes which constitute the nascent consciousness; we may conclude that these relations must be the foundation of all intelligence. And this being the conclusion reached at every successive stage of an analysis pursued quite independently of any such *à priori* consideration, there can, I think, scarcely be a doubt of its correctness.

The various divisions, therefore, which we ordinarily make among our mental operations, and which psychologists have mostly regarded as marking out distinct faculties, have merely a superficial truth. They are to be understood as indicating modifications of detail which distinguish phenomena that are essentially similar—modifications which do but mask that fundamental unity of composition possessed by all cognitions whatever.

§ 381. Contemplating the facts from another point of view, we may see that not only the *form* of thought, but the *process* of thought, is the same throughout. The mode in which the elements of a compound quantitative argument are dealt with by the mind, is essentially similar to the mode in which the elements of every other human thought are dealt with; and the impressions received by inferior intelligences, even down to the very lowest, are dealt with after a like mode.

We saw that all reasoning is definable as the classification of relations. We saw that the perception of an object is possible only by the classing of a present group of attributes and relations with a past group. We saw that the constituents of any complex perception must be severally classed with previously-known constituents of the same order. And

we saw that not even the simplest attribute or relation can be known until there exist others with which it can be ranged; since the knowing it is the thinking of it as one with certain others—the classing it with those others. Nay, the relation of unlikeness itself is cognizable only as like previously-experienced relations of unlikeness—is incognizable unless there exist other relations with which it may be classed. As above hinted, this law applies not to human thought alone. The life of the lowest sentient being is made possible only by an organic classification of impressions. The condition on which every creature exists is, that it shall behave in special ways under special stimuli—that contact with nutritive matter shall modify its motions in a manner different from that in which contact with innutritive matter modifies them—that one impression shall lead it to attack, another to hide, and so on. Manifestly, if there is no adaptation between its acts and surrounding circumstances, it must quickly cease to live. And if it exhibits any adaptation, it can do so only because certain impressions made upon it call forth one kind of action, while others call forth another kind. There must exist in it some means whereby these impressions are distinguished as such or such, or are classified—some organic registry of external differences and similarities. Not that there need be anything like what we know as a consciousness of external differences and similarities: there needs only an innate capability of acting thus or thus, according to the nature of the stimulus. But so far as this implies it, the organism must have a power of appreciating differences and similarities—a power of automatic classification.

Clearly, then, the law is the same throughout. When regarded under its fundamental aspect, the highest reasoning is seen to be one with all the lower forms of human thought, and one with instinct and reflex action, even in their simplest manifestations. The universal process of intelligence is the *assimilation* of impressions. And the

differences displayed in the ascending grades of intelligence are consequent upon the increasing complexity of the impressions assimilated.

§ 382. A further change in our stand-point introduces us to a still wider view of mental phenomena—discloses an exhaustive definition of them, whether considered separately or in their totality.

We have seen that the condition on which alone consciousness can begin to exist, is the occurrence of a change of state; and that this change of state necessarily generates the terms of a relation of unlikeness. We have seen that not simply does consciousness become nascent by virtue of a change, but that consciousness can continue only while changes continue—only while relations of unlikeness are being established. Hence, consciousness can neither arise nor be maintained without the occurrence of differences in its state. It must be ever passing from some one state into a different state. In other words—there must be *a continuous differentiation* of its states.

But we have also seen that the states of consciousness successively arising, can become elements of thought only by being known as like certain before-experienced states. If no note be taken of the different states as they occur—if they pass through consciousness simply as images pass over a mirror; there can be no intelligence, however long the process be continued. Intelligence can arise only by the classification of these states. If they are severally taken note of, it must be as more or less like certain previous ones. They are thinkable only as such or such; that is, as like certain others before-experienced. The act of knowing them is impossible except by classing them with those of the same nature—assimilating them to those of the same nature. In being known, then, each state must become one with certain previous states—must be integrated with those previous states. Each successive act of knowing must be

an act of integrating. That is to say, there must be *a continuous integration* of states of consciousness.

These are the two antagonist processes by which consciousness subsists—the centrifugal and centripetal actions by which its balance is maintained. That there may be the material for thought, consciousness must every moment have its state differentiated. And for the new state hence resulting to become a thought, it must be integrated with before-experienced states. This perpetual alternation is the characteristic of all consciousness from the very lowest to the very highest. It is distinctly typified in that oscillation between two states, constituting the simplest conceivable form of consciousness; and it is illustrated in the most complex thinkings of the most cultivated man.

This law is displayed also in the general progress of thought. These small differentiations and integrations that go on from moment to moment, result in those great differentiations and integrations which constitute mental development. Every case in which an advancing intelligence distinguishes between objects, or phenomena, or laws, that were previously confounded together, implies a differentiation of states of consciousness. And every case in which such advancing intelligence recognizes as of the same essential nature, objects, or phenomena, or laws, that were previously thought distinct, implies an integration of states of consciousness.

Under its most general aspect, therefore, all mental action whatever is definable as *the continuous differentiation and integration of states of consciousness.*

§ 383. The only fact of importance remaining to be pointed out, is the harmony which subsists between this final result and that reached by a kindred science. The widest truth disclosed by the inquiries of biologists is parallel to the one at which we have just arrived.

As there are two antagonist processes by which con-

sciousness is maintained, so there are two antagonist processes by which bodily life is maintained. By the actions it is exposed to every tissue is being differentiated; and every tissue is integrating the materials supplied by the blood. No function can be performed without the differentiation of the tissue performing it; and no tissue is enabled to perform its function save by the integration of nutriment. In the balance of these two actions the organic life is maintained. By each new integration an organ is fitted for being again differentiated; while each new differentiation enables the organ again to integrate. And as with the psychical life, so with the physical—the stopping of either process is the stopping of both.

Moreover the parallel equally holds under the second aspect. Commencing as a uniform mass of matter, every organism is evolved by the differentiation and integration of parts. So, too, on contemplating the phenomena of organization at large as exhibited throughout creation, we find that the integration of elements which perform the same function, goes on *pari passu* with the differentiation of elements which perform diverse functions. That advance from homogeneity to heterogeneity, in which all organization consists, is wholly effected by this duplex action.

Thus, in two senses, there is a continuous differentiation and integration throughout the body; as, in two senses, there is a continuous differentiation and integration throughout the mind.

When we remember that the laws of structure and function must necessarily harmonize; and that the structure and function of the nervous system must conform to the laws of structure and function in general; we shall see that the parallelism here roughly indicated is such as might be expected. We shall see that the ultimate generalizations of Psychology and Physiology must be, as they here appear, different sides of the same primordial truth: both are expressions of the same fundamental process of Life.

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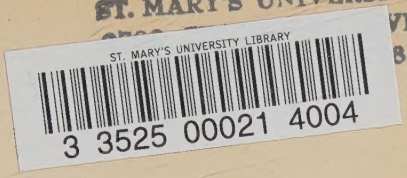

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